

**AN ASSESSMENT OF THE EFFECT OF HUMAN-WILDLIFE CONFLICTS
ON SUSTAINABLE CONSERVATION IN NGORONGORO
CONSERVATION AREA, TANZANIA**

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CERTIFICATION

The undersigned certifies that she has read and hereby recommends for acceptance by the Open University of Tanzania a dissertation entitled: “*An Assessment of the Effect of Human-Wildlife Conflicts on Sustainable Conservation in Ngorongoro Conservation Area, Tanzania*” in partial fulfilment of the requirements for the Degree of Master of Art in Natural Resource Assessment and Management (MANRAM) of the Open University of Tanzania

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DECLARATION

I, **Edwin Charles Nyerembe**, do hereby declare that this dissertation is my own work and that it has not been submitted and will not be presented to any other university for a similar or other degree award.

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.....

Date

DEDICATION

I dedicate this dissertation to my parents, Charles Nyerembe and Winfrida Ebete; my wife Magreth Mashauri, my sons, Nelson Edwin and Nickson Edwin.

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Firstly, I humbly thank my Father in Heaven for taking care of me since I was born to-date, for giving me strength to endure, and all the blessings throughout my life as well as time for studies. Also, I would like to accord my family (my wife Magreth Mashauri, my children, Nelson and Nickson) my sincere gratitude for their unconditional support. In particular, I wish to humbly and sincerely acknowledge my supervisor, Prof. Magreth S. Bushesha, for her advice and guidance during the writing of this report. It is her constructive tenacity and criticism that brought hope and confidence in me, even in depressing moments. She was a true source of inspiration.

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ABSTRACT

This study assessed the effects of human-wildlife conflict on sustainable conservation in Tanzania Conservation Areas. The study used a questionnaire and checklist of questions to collect data from 139 respondents randomly selected in the Ngorongoro division, Ngorongoro district, Arusha region. The data were statistically analysed using Statistical Package for Social Sciences (SPSS) version 20. the study found that Human-Wildlife Conflict (HWC) persists in the NCA. Apart from the menace of buffaloes, elephants, leopards, hyenas, and lions also threatened humans. Moreover, the study found that Wild animals exposed to harassment exhibited aggressive behaviour compared to others. Furthermore, all the domestic animals found in NCA are predated by wild animals, particularly sheep and goats by hyenas prowling at night. Lion's predations occur early in the morning and late in the evening with most victims being livestock trailing behind the flock when herding back home and those lost in the rangeland. HWC in the NCAA is mostly caused by competition over resources by human beings, their livestock, and wild animals. The study observed a significant threat in the HWC caused by change in the wild animals' behaviour. In consequence, the villagers constructed strong fences around bomas and introduced zoning for grazing in some areas suitable for wild animals such as Ngorongoro crater. Thus, the NCAA must continue providing conservation knowledge to the natives, promoting livestock predation compensation schemes, advocating building bomas using strong fences and employ participatory treatment of WHC-related cases. In this regard, the study recommends that natives in the NCAA area need to take precautions to avoid grazing their livestock in areas with a high degree of predation. In addition, relevant authorities should address rabid cases in the NCA.

Keywords: Human, Wildlife conflict in Ngorongoro Conservation

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LIST OF ABBREVIATIONS

AWF	African Wildlife Foundation
FAO	Food and Agriculture Organisation
HWC	Human-Wildlife Conflict
LGCA	Loliondo Game Controlled Area
MA- NRAM	Master of Arts in Natural Resource Assessment and Management
NCA	Ngorongoro Conservation Area
NCAA	Ngorongoro Conservation Area Authority
NGO	Non-Governmental Organisations
OUT	The Open University of Tanzania
SNP	Serengeti National Park
SPSS	IBM Statistical Package and Service Solutions

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter presents information on background to the research, statement of the research problem, objectives of the study, focusing on types of human-wildlife conflicts in the NCA, causes of human-wildlife conflicts in the NCA, community perception on trends of human-wildlife conflicts for the past 10 years in the NCA and community mitigation measures for combating human-wildlife conflicts in the NCA. This chapter also gives information on research questions of the study, significance of the study, scope of the study, and structure of the study

1.2 Background to the Problem

Conflicts between wildlife and people, particularly those sharing the same ecosystem and those in immediate surroundings of the protected areas, are a common global phenomenon (Shemwetta and Kideghesho, 2000). These conflicts occur when there is either a need or behaviour of wildlife to impact negatively on human livelihoods or, conversely, when humans pursue goals that impact negatively on wildlife needs (Stanley *et al.*, 2014). In Africa, human-wildlife conflicts tend to be rife in areas where large herds of big mammals such as elephants and lions roam in marginal rangelands and protected areas (Matindi *et al.* 2015). In fact, conflict between people and wildlife currently rank amongst the main threats to conservation efforts in Africa (Stanley *et al.* 2014).

In Tanzania, wildlife resources constitute a unique natural heritage and resources with great national and global importance (NINA Report, 2005). The costs inflicted by

wildlife conservation on people, and the human problems constraining the wildlife sector in Tanzania have made human-wildlife conflicts one of the major challenges demanding the attention of conservationists (Shemwetta and Kideghesho, 2000). The Ngorongoro Conservation Area (NCA), which is one of Tanzania's protected areas, was established in 1959 to cater for multiple land use, hence allowing for wildlife and humans to live together with their livestock.

The NCA has been designated as a Biosphere Reserve and World Heritage Site highly valued by NCA managers encompassing the Ngorongoro Crater, which is a world-renowned wildlife viewing area; moreover, important archaeological sites are located within the conservation area, showing proof of early humans, including many in the world-famous Olduvai Gorge (Boone *et al.* 2006). The area is inhabited by the Maasai pastoralists who keep their livestock in there and share available resources with wildlife. Overall, the NCA is endowed with a complex community of large grazing mammals accompanied by an equally impressive diversity of large and small predators including 7,500 hyenas, 3,000 lions, 1,000 leopards, 225 cheetahs and wild-dogs (IUCN, 2017). Although Maasai's pastoralists in the NCA exerted a high degree of tolerance of livestock predation by wildlife, the conflict among the two does exist (Swanson, 2007) and constitutes a grave source of concern.

1.3 Statement of the Problem

Since its establishment in 1959, the NCA was designated as a “conservation area” to provide multiple land-use areas for both the resident and migratory wildlife and the natives who had been evicted from the surrounding preserved areas of the Serengeti National Park (SNP) and the Maasai Mara National Reserve (Swanson, 2007).

Initially, pastoralists wandered traditionally throughout the NCA, with their livestock sharing the same ecosystem with wild animals. Then the population of both human beings and livestock did not endanger the co-existence between human activities and wildlife conservation. Minimal human-wildlife conflicts were experienced because traditional pastoralism was widely adopted.

However, things have since changed. There has been a rapid increase in human population in the Ngorongoro Conservation Area from 1959 when the conservation was first established (Swanson, (2007, p 15). According to the NCA (2013), the human population in the NCA has increased from 26,743 in 1988 to 87,851 in 2012, representing a 5.6 percent human population increase. The conflicts, then, are amplified in this small area as wildlife and Maasai livestock compete for valuable resources crucial to their survival (Swanson, 2007).

As consequence, the increase in both human beings and livestock had been observed as a threat to the existence of wildlife conservation in the NCA as per its establishment, hence leading into zoning of the area to restrict access to some areas for pastoralists, including the Ngorongoro Crater and realms of the Embakai Crater. Native pastoralists perceived these restrictions as a threat to their livestock keeping, sparking human-wildlife conflict. Apparently, the extension of the designated protected areas and forced evictions and restrictive access to resource use for local communities from the area coupled with incompatible land-use practices have further exacerbated the human-wildlife conflict.

In fact, the traditional strategies for resolving these conflicts that had existed in pastoral communities have gradually eroded (Matindi *et al.*2015). The question, which

remains unanswered thus far, is: What are the effects of such human-wildlife conflicts on conservation? This study, therefore, seeks to answer this question.

1.4 Objectives of the Study

1.4.1 General Objective

The general objective of the study was to assess the effects of human-wildlife conflict on sustainable conservation in Tanzania Conservation Areas.

1.4.2 Specific Objectives

Based on the main objective, the study specifically sought to:

- (i) Examine the types of human-wildlife conflicts in the NCA.
- (ii) Examine the causes of human-wildlife conflicts in the NCA.
- (iii) Examine community perception on trends of human-wildlife conflicts for the past 10 years in the NCA.
- (iv) Evaluate the community mitigation measures for combating human-wildlife conflicts in the NCA.

1.5 Research Questions of the Study

Based on the specific objectives of the study, the study sought to answer the following research questions:

- (i) What are the types of human-wildlife conflicts in the NCA?
- (ii) What are the causes of human-wildlife conflicts in the NCA?
- (iii) What are communitys' perceptions the trends of human-wildlife conflicts for the past 10 years in the NCA and compare among variables?

- (iv) What are the community members opinions on the potentially viable mitigation measures for combating human-wildlife conflicts in Tanzania Conservation Areas?

1.6 Significance of the Study

The significance of this study was four-fold. To begin with, the study findings could be used by planners and policy-makers for the NCA to address properly some of the prevailing HWC issues to engender sustainable conservation. Second, the study's findings on the causes of HWC in the NCA could also be useful to planners and policy-makers for NCA in an attempt to address potential causes of human-wildlife conflicts for sustainable conservation. Third, by examining the community perceptions of the trends of HWC for the past 10 years in the NCA and compare among variables, the study's findings could help planners and policy-makers for NCA re-evaluate their degree of success or failure in addressing HWC for the past ten years concerning different variables. Fourth, by studying the community opinions on the potentially viable mitigation measure for combating human-wildlife conflicts in the NCA, the study findings could be used by planners and policy-makers for the NCA to map out the mitigation measures in resolving HWC for sustainable conservation.

Apart from these policy and operational benefits, the study contributes to the body of knowledge on the effects of human-wildlife conflict on sustainable conservation in the Ngorongoro Conservation Area (NCA). In this regard, other researchers could use these findings as background information and as materials to contextualise their researches on related topics.

1.7 Structure of the Study

The study was organized in five chapters, starting with background information for study, literature review, research methodology, finding and discussion as well as conclusion and recommendations. The study was conducted at Ngorongoro Conservation Area (NCA). The study used cross-sectional research methodology whereby data was collected once during the study using questionnaire and checklist. This study explored information from head of households in the NCA using quantitative and qualitative research approach. Research developed questionnaire formed a tool for quantitative data collection mechanism while checklist was used in qualitative data collection mechanism.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews both theoretical empirical literature on pastoralism and conservation in the NCAA, pastoralism and wildlife conflict, and human-wildlife conflict mitigation measures. The chapter also reviews policy on human-wildlife conflict by looking at the National Land Policy 1995 and the Wildlife Policy of Tanzania, 1999. Finally, the chapter establishes the knowledge gap on the human-wildlife conflict in the context of the NCA that the study set out to fill. Additionally, the study presents the conceptual framework that informed the study.

2.2 Theoretical Review

The theory behind the human-wildlife conflict is based on Peterson *et al.* (2010). In this regard, the author and colleagues state that:

Understanding the changing social contexts for conflict between conservation and human welfare is central to biodiversity conservation. Conflicts associated with biodiversity conservation reflect material as well as socially constructed realities. Considerable research documents, the material conditions where promoting human welfare while simultaneously conserving biodiversity appear incompatible (as cited in Billé et al. (2012).

Apparently, human-wildlife interactions occur in many contexts, including recreation, hunting, transportation, land use, and passive-appreciation activities (Morzillo *et al.* 2014). From a human perspective, such interactions constitute a continuum spanning from the positive to negative elements and, eventually, result in a continuous need for assessment to manage potential human-wildlife conflict.

Using “judiciary discourse”, Blakesley (2007) describes rhetoric as the “determined ordering of undetermined elements (images)” and facilitates links between rhetoric and narration. In conjunction with the initial transformation from rhetoric to syntagmatic, this second metamorphosis from rhetoric to narration equates rhetoric to the semiosis of cinematic narrative proposed by Metz’s *Grande Syntagmatique*, which neglects processes of persuasion or influence, and returns rhetoric to the realm of grammatical precepts and structures.

Peterson *et al.* (2010) contends that “[a]lthough all human experience is grounded in material reality; materiality alone is insufficient to motivate social action” as people's past experiences, beliefs, and values frame their perceptions. These frames induce what is an important and shape people’s interpretation of their material reality. One practical way of identifying and shape future frames is to assess how they are instantiated through language. The focus on rhetorical framing or language entails considering how they are deployed to catalyse identification and co-operation among humans, which is vital in determining human-wildlife conflict.

In fact, rhetoric affects human motivation and action by shaping vocabulary. Such vocabulary form ‘terministic’ screens, wherein individual terms interact to underscore some aspects of reality while de-emphasizing others. These terministic screens that people employ enable them to factor in and discuss the significance, meaning, and demands of their experience. In fact, terministic screens shape how the society responds to environmental challenges by constraining possibilities. According to Almqvist *et al.* (2010);

The interactions within communities of organisms at population and community level play a key role in determining the stability and resilience of the ecosystem. Communities are structured by multiple biotic processes, and external conditions may strongly influence the outcome. Some species have a disproportionate influence on ecosystem functioning relative to their biomass and abundance, and the loss of such a “keystone” species has cascading effects on community diversity and ecosystem functioning.

Similarly, Peterson *et al.* (2010) noted that though conservation benefits of terministic shift are debatable, there has been a major shift as. Terministic screens have become problematic in biodiversity conservation contexts, particularly when they frame the needs of humans and wildlife as stemming from conscious hostility. These terministic screens formed by the phrase ‘human-wildlife conflict’ underscores conscious hostility between wildlife and humans. Cases, where the resource demands the striking of a balance between humans and wildlife constitute human-wildlife coexistence, or human-wildlife competition, or—worse still—human-human conflict.

As a matter of fact, the human-wildlife conflict terministic screen frames some of the most high-profile wildlife conservation causes in the world. Conflict becomes well-developed when it is treated as an interdisciplinary concept. In this regard, definitions generally converge around what can be dubbed “expressed disagreements” among people or interested parties who treat the incompatible goal and potential interference prevailing in attaining set goals.

On the whole, environmental conflicts do implicate consciousness and social interaction and are hugely political and tend to be linked to power relationships and values. Also, the version of conflict excludes most wildlife species as parties to the conflict because few of these wild species could be construed as simultaneously

conscious of their own goals; aware of human goals, and purposefully seek to undermine human goal-seeking capacity, (Peterson *et al.* 2010)

2.3 Empirical Literature Review

In this section of literature review, there is description related to Pastoralism and Conservation in the NCAA, Pastoralism and Wildlife Conflict, Human-Wildlife Conflict Mitigation Measure, Policy review, National Land Policy, 1995, Wildlife Policy of Tanzania, 1999, Solving human-wildlife conflicts, Strategies for solving human-wildlife conflicts, Alternative strategies, Habitat Selection Theory, Conceptual Framework and Knowledge Gap for the study.

2.3.1 Pastoralism and Conservation in the NCAA

The most recent residents of Ngorongoro are the Datoga and the well-known Maasai ethnic groups (Swanson, 2007, p 13). These peoples are predominantly pastoralists with transhumance lifestyles. The Maasai traditionally are not bush meat-eaters, a habit that could be the cause of the existence of wildlife in the areas they reside. Before and during the colonial eras the Maasai pastoralists could settle in parts of what is called Serengeti National Park (SNP) and that of Ngorongoro plains as well as the crater. They can share the eco-system with wildlife. However, their tendency of setting fire as a means for pasture management as well as cutting of trees for building poles reduced the trust the conservationists had in them. Consequently, they were expelled from SNP by 1959 (Salazar, 2014).

The establishment of NCA in 1959 was meant to serve multiple land use for both the residents and migratory wildlife and the native residents who had been evicted from

the surrounding preserved areas of the SNP and the Maasai Mara National Reserve (Swanson, 2007). The increase of the pastoralist population in the NCA had been supported by the more or less stable number of livestock due to drought and prevalence of livestock diseases (McCabe, 1997). Hence, there was a need for some pastoralists to engage in cultivation as a means of subsidizing their source of food. In this regard, Swanson (2007) documents:

About 85% of NCA Maasai were cultivating either maize or various root crops depending on their location whereby maize being grown in the lowland grass ecosystem, whereas root crops were more productive in the highland regions. The author noted that grain intake supplied approximately 65% of the caloric intake of the NCA Maasai, however, cultivation fulfilled only 50% of this needed intake. The remaining grain was purchased at markets by livestock trading in which mostly cows were sold (47%), followed by steers (27%), and finally bulls (20%), (Swanson, 2007, p. 32).

Usually, cultivation, pastoralism, and wildlife are incompatible. Pastoralists engagement in cultivation in the NCA threatened not only the wellbeing of wildlife but also the existence of the so-called pastoralism in the NCAA (Homewood and Rodgers (2004). Eventually, voices from conservators raised concern on its ban for sustainable conservation of the NCAA.

Generally, it is customary of pastoralists to show the transhumance lifestyle of herding their livestock in the quest for pastures and water (Hazard *et al.* 2012). This lifestyle reduces the chances of overgrazing by providing an environment for wildlife to co-exist with livestock. Currently, the Maasai of the NCA was increasingly exhibiting sedentary lifestyle that has seen them start constructing more or fewer permanent housing structures (Coast, 2001). Although most of their livestock assumes seasonal migration to various parts of the NCAA in search of water and pasture, some of them

remain in Maasai bomas for milk to those who do not move in nomadic style with their livestock, especially elders and children (Kisoza, 2007). The sedentary lifestyles of these pastoralists eventually translate into overgrazing in areas near their bomas, hence threatening the co-existence of humans and wildlife in the NCAA (Coughenour & Reid, 1999).

2.3.2 Pastoralism and Wildlife Conflict

Usually, pastoralists have relatively been living in harmony with wildlife (Biru *et al.* 2017). There are beliefs that wild animals are an integral part of livestock and that separating them can trigger an imbalance in the ecosystem. As such, no matter how many injuries the wild animals cause to human beings and/ or livestock, their tension is manageable for preserving co-existence persists (Mponzi *et al.* (2014).

Traditionally, at a certain age, youths are obliged to participate in hunting some wild animals as part of ceremonials (Gardner, 2016; Tian, 2016). At 14 years, Maasai youth undergo circumcisions coupled with making crowns that are made of birds' feathers (Hodgson, 2001; Bruner & Kirshenblatt Gimblett, 1994). Many birds with bright feathers tend to be casualties during the ceremony.

It is customary for a youth to be called a hero when he manages to kill dangerous animals such as a lion or leopard. This tradition has been criticised by conservationists as such killing continue when livestock are attacked by these wild animals. When wild animals such as lions kill livestock, youth exhibit their courage and kill the wild animals. In the NCAA, when wild animals are being killed in revenge attacks after they had raided and killed livestock, the culprits are hunted down, caught and

prosecuted. The reactions by the conservator toward the killing of wildlife by pastoralists are relative faster compared to the payment of compensation to pastoralists whose livestock was killed by wildlife. These situations usually tend to make pastoralists feel disadvantaged in the process of managing the NCAA. According to Swanson (2007), “Usually the Maasai pastoralists are not natural enemies of the wildlife of Ngorongoro, but unresolved or unaddressed conflicts may lead to the exploitation of wildlife to make voices heard.(P 53)

2.3.3 Human-Wildlife Conflict Mitigation Measure

Lessons learned from the African Wildlife Foundation (AWF) heartlands (Muruthi, 2005) elicit two basic approaches to managing human-wildlife conflicts: Prevention and mitigation. Preventive measures can prevent or ease the risk of conflicts arising between people and animals and include extreme measures such as completely removing either the people or the animals from the disputed environment or physically separating the two using barriers, and employing a variety of tactics capable of scaring and repelling wild animals. Muruthi (2005) further observes that, although prevention is the best option, at times reactive approaches are required after human-wildlife conflicts have occurred.

To prevent the occurrence of HWC, FAO (2010), noted that, the first step is to raise the awareness of people who live in a wildlife populated area and of the potential consequences. After all, living, working, or traveling in areas with large carnivores calls for preparedness. The second step entails prevention, which consists of being alert, having sound knowledge of the environment, and predator habits and using strategies to reduce the likelihood of being viewed as prey.

The customary ways of herding livestock requiring young boys to protect herds at night, rather than elders increased the chances of the livestock being raided by wild animals. For lions, the best way to avoid conflict is to erect lion-proof *bomas*. “Lion-proof” refers to *bomas* with sufficiently high and strong enclosure to prevent cattle from breaking out and lions from jumping in (Chardonnet *et al.* 2010). Many devices can help deter lion attacks.

The two main types are those that frighten and those that cause aversion. Fires can be kept burning at night in areas where animals make regular raids. The most common deterrents are dogs and human guards with guns. Additionally, deterrent solar lights, which are installed around pastoralist bomas, prevent predators from entering the boma at night and raid the livestock (Manoa & Mwaura, 2016).

According to FAO (2010), compensation schemes seek to prevent people who bear the costs of living with wildlife from becoming enemies of conservation. In this regard, the compensation mechanism must balance the costs of damage victims incurred with benefits provided by income-generating activities or by state agencies or non-governmental organisations (NGOs). Such compensation accords victims monetary or in-kind subsidies. Sometimes, Compensation is directed towards households; more often, however, it was towards communities.

In uncontrolled remote areas where wildlife damage occurs, victims tend to seek compensation by recovering payment for losses, including by killing the ravenous animals and obtaining bush meat and cash from wildlife resources (Chardonnet *et al.* 2010).

2.4 Policy Review

This section reviews the National Land Policy, 1995 and the Wildlife Policy of Tanzania, 1999; particularly how they have addressed the Human Wild Conflict in the context of pastoralism that dominates the Ngorongoro Conservation Area.

2.4.1 National Land Policy, 1995

The National Land Policy, 1995, has the overall aim of promoting and ensuring a secure land tenure system to encourage optimal use of land resources and facilitate broad-based socio-economic development without endangering the environment. The increases in human and livestock populations justify the formulation of the land policy. In fact, the livestock population has heightened the demand for grazing land, created soil erosion, and led to conflicts. Moreover, the free movement of pastoralists with their cattle breeds land ownership and land-use conflicts with settled communities in such situations, shifting agriculture and nomadism tend to be prohibited.

The National Land Policy of 1995 and the Village Land Act of 1999 make legal provisions for securing land rights for extensive grazing systems. Under the present land laws, there are no restrictions imposed on accessing land in this country. Any person, citizen, or foreigner can apply and be allocated land for any type of use. This has facilitated the acquisition of land for speculative purposes, especially in prime agricultural, industrial, commercial, and residential areas. The policy statement indicates that all citizens shall have equal and equitable access to land. In this regard, individuals should be allowed to obtain individual title-deeds within an area not designated for communal uses, land conservation, and other specified village or

community projects. According to Kipuri *et al.* (2008), the NCAA has the mandate to control all land use, commercial activity, entry and residence within the NCA as stipulated under the NCA Ordinance. Despite acknowledging pastoralism as a sustainable land-use system, the NCAA has restricted pastoralist grazing and land management practices in a bid to preserve tourism and boost conservation interests in NCA. Thus, pastoralists are excluded from prime grazing sites in various parts of the NCA and must get permits to take livestock down into the Ngorongoro crater to access mineral salts. They are also not allowed to burn the greeneries of the NCA. Yet, it is debatable whether village by-laws or other village-based regulations on pasture and water use are binding within the legal set-up of NCA, and whether customary arrangements get the nod.

2.4.2 Wildlife Policy of Tanzania, 1999

The formulation of the Wildlife Policy 1999 recognises the need for changing how wildlife resources should be managed and conserved in Tanzania. The policy aims to involve a broader section of society in wildlife conservation, particularly rural communities, and the private sector. The policy treats wildlife conservation as a vital activity that ought to compete with other forms of land use, as it can generate a substantial amount of revenue and foreign exchange for the state. The policy also promotes local community participation in conserving and utilising wildlife resources.

(a) Solving human-wildlife Conflicts

The Wildlife Policy 1999 stipulates that there is a need to regulate wildlife, which threatens or damages human life and property. As such, the government draws the attention to the economic value of wildlife to rural communities via community-based

conservation. In executing this policy, the government works on the assumption that rural communities who manage wildlife would realise the inherent conflict that exist between the objective of maximising earnings from wildlife, and reduced productivity, which could result from excessive control of the problem animals. Accordingly, the government does not strive to introduce a compensation scheme for wildlife damage for improving local benefits.

(b) Strategies for solving human-wildlife conflicts

- (i) Continuing to control dangerous animal species as a matter of priority, and
- (ii) Devolving progressively the responsibility for problem animal control to rural communities operating CBC programmes, and continuing to give assistance where rural communities have not developed this capability.

(c) Alternative strategies

In the long-term, there are alternative strategies aimed to reduce the conflict between people and wildlife. Possibilities include incorporating the numbers of animals shot as problem animal control into hunting quotas that can accord greater economic benefits for rural communities, ensure that those most affected by problem animals are the main beneficiaries of revenue accruing from wildlife, explore the use of control methods which rely on mechanical and electrical deterrents, which are non-lethal. Also, where practical, the actions taken would include capturing and translocating wildlife of high commercial value as well as and publicising the economic value of wildlife, especially among rural communities operating community-based conservation schemes.

2.5 Habitat Selection Theory

Habitat-selection theory can be applied to solve numerous problems in the conservation and management of wildlife (Moris, 2003). Based on Rosenzweig, (1981), “A graphical theory of habitat selection is built in steps. The theory treats two species in an environment with two usable patch types in a matrix of unusable space. The first step assumes habitat selection is density independent and free of search costs. The second assumes density independence, and the third assumes neither.

The first two steps produce results already known from earlier theories. The third, however, requires a new analytical device, the isoleg, which is a line in a two—dimensional—state space of the two species' densities. An isoleg is a set of points in such a density space, such that on one side of the set, individuals of a species optimize their foraging by being strict habitat selectors, whereas on the other side, they do so by using at least a bit of a poorer patch. The population dynamics of the competitors is analyzed using their isolegs. The isolegs allow us to deduce that the zero isoclines of the species are warped into nonlinear forms capable of producing competitive coexistence. It is shown that at the equilibrium point of this coexistence, there may be no overt competition remaining. The difficulties this presents to the field investigator are mentioned, and a modified definition of interspecific competition is suggested.”

According to Moris, (2003). “In solving numerous problems in the conservation and management of wildlife, many of the solutions involve the use of habitat isodars, graphs of densities in pairs of habitats such that expected fitness is the same in both. For single species, isodars reflect differences in habitat quality, and specify the conditions when population density will, or will not, match the abundance of

resources. When two or more species co-occur, isodars can be used to assess not only whether the species compete with one another, but also differences in habitat, in habitat selection, and in the functional form of density-dependent competition. Isodars have been applied to measure scales of habitat selection, the presence or absence of edge effects, as well as the number of habitats that species recognize in heterogeneous landscapes. Merged with foraging behavior, isodars reveal the relative roles of habitat selection, spatial structure, and environmental stochasticity on local populations.

Habitat-selection models can be linked similarly with theories of patch use to assess the underlying cause of source–sink dynamics. Isodars can detect and measure Allee effects, describe human habitat selection, and use human occupation of habitat as a leading indicator of threatened biodiversity. Even so, we have only begun to reveal the potential of habitat selection, and other optimal behaviors, to solve pressing problems in conservation and management.”

According to Stamps, (2001), “Evolution by natural selection comes in three flavors: namely density-independent, density-dependent, and frequency dependent. Density independent selection means that the fitness consequences of an organism’s heritable traits remained uninfluenced by the population. Natural selection produces adaptations maximizing population growth rates. Density –dependency selection means that the population size does influence the fitness consequences of an organism’s traits.

Density-dependent selection produces adaptations to maximize the population’s size. Frequency-dependent selection means that the fitness consequences of an individual’s traits are influenced by others’ traits and the frequency of particular traits within the

population. Frequency-dependent selection produces adaptations, but these adaptations neither maximize population growth rates nor maximize sizes.”

Rosenzweig, (1981) urge that, “Density-pendent dispersal is explicit in more sophisticated models that assess movement through landscapes of varying habitat quality. Also, dispersal kernels and movement rules, often are used by landscape ecologists to predict abundance and distribution in heterogeneous environment. Habitat stands front and center in wildlife management and conservation, where ecologists use sophisticated tools to describe spatially explicit resource use. These empirical models often are then used to map habitat quality at various spatial scales and to inform managers on the future availability and use of habitats. “Resource-selection functions can be used to identify “critical habitat” of endangered or threatened species, to help assess the viability of populations, and to aid in understanding the consequences of changing land-use and climate.”

2.6 Conceptual Framework

The conceptual framework of this study is based on Patana *et al.* (2018). A conceptual framework for evaluating human-wildlife interactions and feedbacks tends to be coupled with the human and natural system. Wildlife related event and a human reaction (Box 2) results in an effect. Such effects can influence human behaviour (Box 6). Though individual human characteristics (Box 5) can influence reactions and behaviours, human behaviours serve (Box 6) not only as drivers of wildlife management and policy (Box 10) but also human behaviour. Eventually, this results in an impact with either direct or indirect feedbacks that afflict wildlife. Changes to the rangelands (Box 8) because of human behaviours (Box 6) occur across multiple

scales, land use (Box 9) affects rangeland characteristics (Box 8) and environmental policy (Box 10) limits human behaviour (Box 6) for the benefit of humans and wildlife species.”

Based on Patana *et al.* (2018), impact-based feedbacks (Box 3) tend to affect human conduct directly or indirectly related to physical contact between humans and wildlife, i.e., “behaviour-based feedbacks.” Direct behaviour-based feedbacks occur when a human physically observes an animal (Box 6,4). In contrast, indirect behaviour-based feedbacks can be more circuitous and occurs as evidence of wildlife. Other factors that induce human conduct include the context, wildlife species, frequency of interactions with wildlife, the extent of damage, and perceived risk.

Both direct and indirect effect, affecting human conduct could induce ongoing animal presence. When it comes to wanton, killing animals, such indiscriminate acts result in the extermination of current and future events by that individual animal. Hypothetically, other individual animals could later inhabit the location and provoke future conflict. Alternatively, scaring an animal or fixing a habitat-based object of the impact initiate new events that could lead to further effects (Box 7). As such, humans actively physically transform rangeland characteristics (Box 8). Whether those human conducts afflict wildlife positively or negatively depends on a human’s motivation for contact.

Furthermore, according to Patana *et al.* (2018), the alteration in habitat is one of the greatest challenges to wildlife management as any variation in vegetation and development characteristics could influence wildlife composition, hence a flash point

for conflict between wildlife and humans. In addition, concurrent use of resources by both humans and wildlife and the resultant conflict, affect rangeland and habitat quality, for both human and wildlife perspectives, respectively. In the meantime, this development could lead to lethal consequences for wildlife at the hands of humans.

Furthermore, the desire to protect wildlife habitats and human health has resulted in local-to-global policy that limits human conduct capable of harming both wildlife and humans. Thus, regulating human conduct detrimental to wildlife, in turn, can affect the quality of habitat resources. Also, Patana *et al.* (2018) contend that a positive or negative effect results from wildlife-related event that triggers a human reaction (Bo 2).

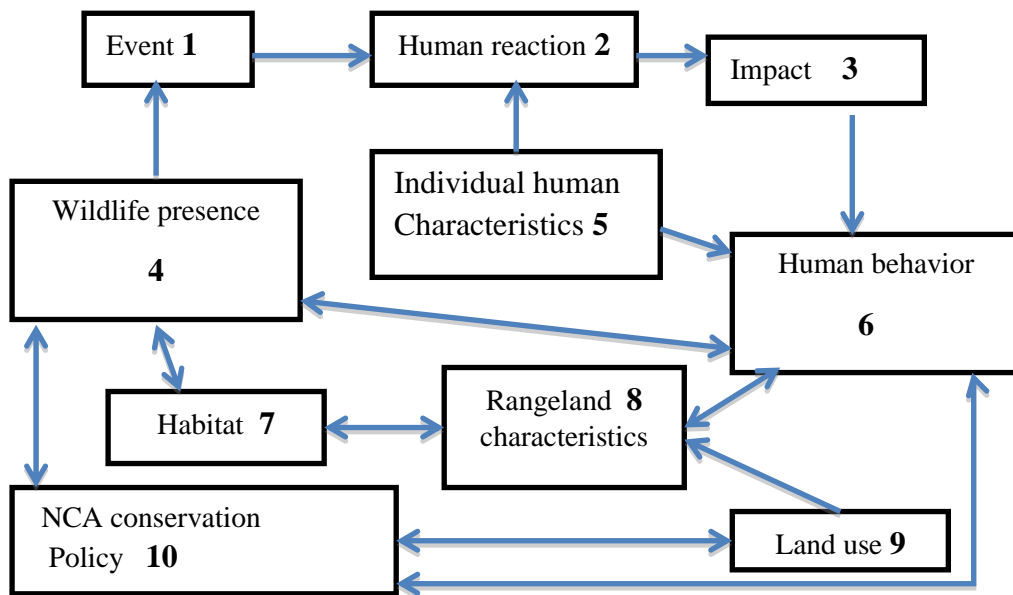


Figure 2.1: Conceptual Framework

Source: Modified from Patana *et al.* (2018)

Both the human reaction to an event (positive versus negative) and the result and conduct occasioned by an impact affect wildlife and are induced by complex

interactions of human characteristics such as environmental values and value orientations attitudes toward wildlife, interest in sight-seeing, attitudes toward particular species, risk perception, and other cognitive and motivational variables. Overall, collectively, these constructs influence and interact with each other, i.e., feedbacks, to form wildlife relationships, i.e., “impact-based feedbacks”, and drivers of wildlife management as part of environmental policy (Box 10).

2.7 Knowledge Gap

For a long period generally, pastoralists have been living in harmony with wild animals (Biru *et al.* 2017). They believe that livestock must live in co-existence with wildlife such that neither of them can live alone (Niamir-Fuller *et al.*, 2012). During the colonial era, Maasai pastoralists could wander over all Serengeti National Park in addition to Ngorongoro and Loliondo areas (Goldman, 2011).

According to Salazar (2014), before 1959 most conservators called for the evacuation of the Maasai from Serengeti National Park because of their habit of using trees in house and boma construction in addition to setting fire for tick control. When pastoralists were transferred to live in the Ngorongoro in 1959, they were initially allowed to wander all over the land in the area but, currently, they were not allowed to herd their cattle in the Ngorongoro crater as they create an unfavourable environment for wildlife.

According to Salazar (2009), the Ngorongoro Conservation Area is one of the places where human being with their livestock can co-exist with wildlife. Traditionally, the Maasai pastoralists, who dominate the NCAA, did not engage in agriculture as

farming competes with livestock for pasture land but in the 1970s and 1990s they wanted to be allowed to engage in farming, a threat to conservation (Cooke, 2007). Different studies indicate that protracted human-wildlife conflict without taking remedial measures result in people destroying the wildlife to make their voices heard (Songorwa, 1999; Colchester, 2004; Heydon, *et al.* 2011). Thus, more research needs to be conducted in the NCAA to explore the presence of human-wildlife conflict, ways of alleviating it, and its mitigation measures for sustainable conservation.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research methodology applied in the study. Specifically, it describes the study area and location; climate, vegetation, water resources, and population change over time. It also presents information on major economic activities, social services in the study area, focus population, research strategy, research design, the internal and external validity of the study. Furthermore, it details the sample size and sampling techniques, tools for data collection, location, and data availability, methods of data analysis and interpretation as well as problems that arose during the study together with ethical considerations.

3.2 Description of the Study Area

Ngorongoro is famous for its wildlife both for diversity and density (Swanson, 2007). In fact, the wildlife of Ngorongoro crater has contributed to an area becoming the “Eighth Wonder of the World.” In this regard, the area boasts of the highest density of predators in the world and a viable population of the endangered Black rhino, *Dicerosbicornis* (Swanson, 2007, p 16). According to Boone *et al.* (2006), the NCA covers the Ngorongoro crater, which is a world-renowned wildlife viewing area and important archaeological sites, with evidence of early humans, including many in the world-famous Olduvai.

According to the IUCN (2017), the NCA is endowed with a complex community of large grazing mammals accompanied by an equally impressive diversity of large and

small predators including as many as 7,500 hyenas, 3,000 lions, 1,000 leopards, 225 cheetahs, and innumerable wild dogs. In this regard, the IUCN observes that the NCA's mammalian population is an integral part of the most diverse and complex savannah community on planet Earth. Its population includes 1.3 million wildebeest, 600,000 zebras, 900,000 Thomson's gazelle and large numbers of other species such as the buffalo, eland, giraffe, warthog, elephant, hippopotamus, and the black rhino (IUCN, 2017).

3.2.1 Map of the Study Area

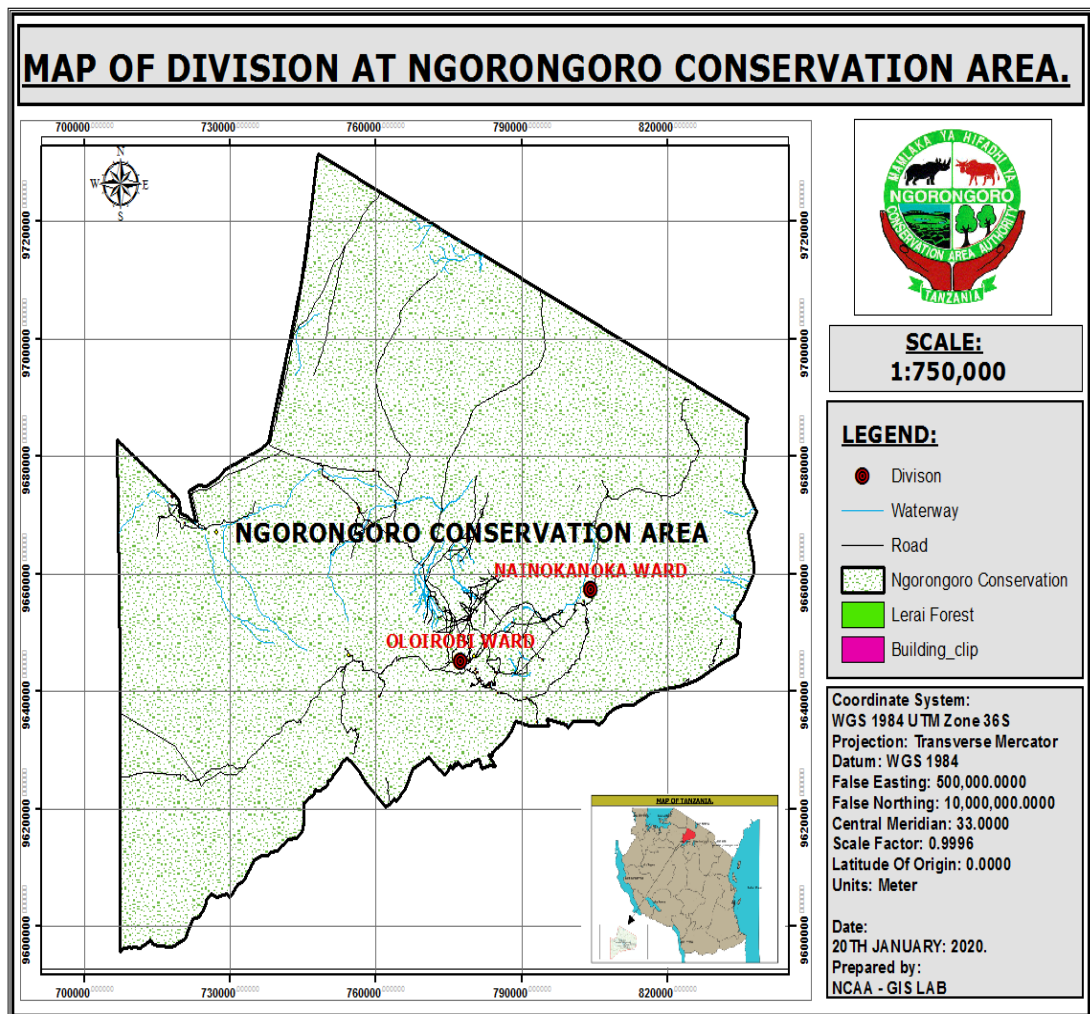


Figure 3.1: Map of Ngorongoro Conservation Area Authority

3.2.2 Location of the Study Area

The NCA lies at the southern end of the wider Serengeti ecosystem—one of the last intact ecosystems in the world, which includes protected areas 35,567 km² (IUCN, (2017), The NCA is in Northern Tanzania (340 52 - 350 58 E, 2030 – 3038 S) and covers 8, 283km² (Elliott, 2010). It borders Loliondo Game Controlled Area (LGCA) to the North, the Serengeti National Park to the west, Lake Eyasi to the south and agricultural communities on the south-eastern border at Karatu district (Elliot, 2010).

3.2.3 Climate of the Study Area

Ecologically, the area is marked by the diversity. It has five ecological zones: The Crater highlands, Salei plains, Gol Mountains, Serengeti plains, and Kakesio/Eyasi escarpment. Rainfall in the area is seasonal and highly variable ranging from 400 to 600 mm in the lowland plains to more than 1200 mm per annum in the highland areas.

3.2.4 Vegetation Cover

According to Swanson (2007), the borders of the NCA encompass a great variety of ecosystems including montane forest, swamps, marshes, and dry forest, as well as long and short grasslands that are extensions of the Maasai Mara and Serengeti ecosystems. Such diverse ecosystems enable diverse wildlife species in their significant numbers to thrive within the conservation area. The vegetation of the Ngorongoro is highly dependent upon location as this feature accounts for variations in water inundation, salinity, and pH levels. The dominant ecosystem can be found within the Crater, where there are tall and short grasslands. The dominance of short or tall grasslands depends on the underlying soil structure such as its porosity and the

extent of compaction. The most palatable short grass species include *Sporobolus*, *Digitaria*, and *Cynodon*. Such short grasslands can be located surrounding Lake Makat in the lacustrine sediment and the northwest corner of the greater NCA. Other species common to this short grass association are Cut leaf Medic (*Medicagolaciniata*), Rhodes Grass (*Chlorisgayana*), and *Aster hyssopifolius* (Swanson, 2007).

Long grass species in these areas include red oat grass (*Themodatriandra*), golden tipped *Chloris*, *Hyparrhenia*, *Aristida*, and tufted *Pennisetum*. The plant species growing in swampy conditions within the Crater are tolerant of or require regular inundation with water of varying salinities. Moreover, the Gorigor and Mandusi swamps are dominated by the water-loving sedges *Cyperus papyrus* and *Cyperusimmensus*, as well as Lowveld Reed (*Phragmitesmauritanus*). Other species found in the area include Smooth Flats edge (*Cyperuslaevigatus*), Rice Cutgrass (*Leersiahexandra*), Creeping Panicum (*Panicumrepens*), and Brown Beetle Grass (*Diplachnefusca*), according to Swanson (2007).

Overall, the swamps in Ngorongoro do not support woody vegetation because of the thin soils found in the area; as a result, the long grass species dominate. Around the swamps also grow grasslands that consist of tall, coarse grass engendered by the wet saline-alkali soil association. This system, which is composed of alluvial sediments and experiences a seasonally high water-table, is also be found around Lerai Forest. The edges of the swamps are extremely valuable for grazing during the dry season when the more preferred grasslands dry out (Swanson, 2007). Species in these

locations include Rhodes Grass (*Chloris gayana*), Stargrass (*Cynodon plectostachyus*), Bermuda grass (*Cynodon dactylon*), and *Spilanthes mauritiana*.

The Crater Highlands account for tree associations with regions of grasslands akin to those of the Crater floor. Common tree species include *Acacia lahai*, *Croton* spp., *Cassipourea malosana*, *Albizia gummifera*, and *Nuxia congesta*. Though the highlands can fall under the category of the rain forest, they are called “montane” because of their “higher altitude and lower and more variable temperature and rainfall (ibid.) The moisture provided by the rain and the blanketing fog is amenable to the growth of ferns, mosses, and lichens that are found within the canyons. Furthermore, there is a significant variety of shrubs and flowering plants that grow in these forests, (Swanson, 2007).

3.2.5 Water Resources

Homewood *et al.* (2004) noted that the NCAA is home to both natural and artificial water sources. The main water sources are evident in the crater’s highland catchment that provides water for wildlife, livestock, and humans found near to the area. About 23 permanent streams supply water in 500 km². Some small streams drain their water into the crater-like Munge River while others water drain in the depression such as Olbalbal, which hold water up to 10 months in a wet year. Borehole water sources are frequently blackish and mostly saline, hence making the water unpalatable for human consumption. Also, the deep groundwater and water from permanent spring over the plain west of the Ngorongoro Crater have a high amount of saline and fluoride than shallow groundwater and seasonal spring.

3.2.6 Population Changes Over Time

Data from the Ngorongoro Conservation Area Authority (NCAA) shows a rise in human population from 26,743 in 1988 to 87,851 in 2012, a 5.6 percent increase per annum (*Masao et al.*, 2015). Table 3.1 presents the population trends from 1954 to 2012:

Table 3.1: Population Trends in the NCAA

Year	1954	1966	1970	1974	1988	1993	2002	2007	2012
Population	10,633	7,387	5,435	12,665	22,743	37,352	56,856	64,842	87,851

Source: Melita and Mendlinger (2013); *Masao et al.* (2015)

3.2.7 Major Economic Activities

For centuries, Ngorongoro has been home to more than 80,000 pastoralists and hunter and gatherers. Apart from small numbers of the Datoga and the Hadzabe, most of the inhabitants are Maasai, who feature prominently on tourist posters and brochures as a human symbol of Tanzania's indigenous populations and cultural heritage. The area was established in 1959 as multiple land-use areas, with wildlife coexisting with semi-nomadic Maasai pastoralists practising traditional livestock grazing (Swanson, 2007).

3.2.8 Social Services in the Study Area

Since its establishment in 1959, the NCA has been responsible for community development. Pastoral Council has been formed, given funds to address social services such as education and water. The NCAA works in collaboration with the district council in providing social services such as education by offering sponsorship to students from secondary level to university, supporting the construction of schools, propping up the operation of schools e.g. provision of vehicles and fuel to two

secondary schools of Embarway and Nainokanoka. Health services including rendering support in form of medical provisions e.g. Makao and Enduleni hospitals, support in medical referral expenses, livestock extension services such provision of vaccines to livestock e.g. Anthrax, CPPP, CCPP and PPR are other social services provided in the area. The NCAA also helps the community to build necessary infrastructure for livestock such as boreholes, cattle-dips, crushes, dams, and cattle troughs. (Source: This study 2020)

3.2.9 Focus Population

According to Swanson (2007), the most ancient ethnic groups in the Ngorongoro area are the Hadzabe or the Watindiga. The most recent residents of Ngorongoro are the Datoga and the now well-known, illustrious, and established Maasai. This study, therefore, mainly focused on the Maasai and the Datoga.

3.2.10 Research Design

This study used a cross-sectional research design whereby data was collected once during field research (Ary et al. 2010). Data were collected in two weeks followed by data coding, analysis, and interpretation. Information was collected from randomly selected respondents under a quantitative approach with key informants taking part in focus group discussions (FGDs). A well-structured questionnaire was administered to ensure both internal and external validity were attained as explained hereunder.

3.3 Research Strategy

This study used both quantitative and qualitative research strategies. This study used the quantitative strategy to determine the current types of human-wildlife conflicts in

the NCA, current causes of human-wildlife conflicts in the NCA, the community perception on the trends of human-wildlife conflicts in the past 10 years in the NCA and compare and contrast the variables and the community opinions on the best mitigation measure for combating human-wildlife conflicts in the NCA. The quantitative research approach, on the other hand, facilitated the comparing of different variables presented in different formats such as charts and graphs (Source: This study 2020).

To give more room for respondents to air their understandings, a qualitative approach was used to get the answers to the research questions for this study on the current types of human-wildlife conflicts in the NCA, current causes of human-wildlife conflicts in the NCA, the community perception on the trends of human-wildlife conflicts for the past 10 years in the NCA, and the community opinions on the best mitigation measure for combating human-wildlife conflicts in the NCA, (Source: This study 2020)

3.4 Sample Size and Sampling Techniques

Based on Ary *et al.* (2010, p 289), the sample size is an important consideration and requires taking into account the validity and reliability of the findings, the time needed to carry out the study, and the resources available: “The researcher decides on an acceptable margin of error and then computes a sample size”. Thus, the sample for this study was calculated using the following formula:

$$n = \left(\frac{1/E}{\sqrt{pq}} \right)^2 (Z)^2$$

Where n=sample size needed

E=desired margin of error

pq=variance of hypothesized proportions

z= z score of confidence level

The desired error of margin is 5% with an expectation of 90% of the respondents was voluntarily agreed to participate in the study; therefore a .95-confidence level was used to calculate the sample size for this study. Hence the sample size for this study was calculated as follow:

$$n = \left(\frac{1/0.05}{\sqrt{0.9 \times 0.1}} \right)^2 (1.96)^2$$

$$n=139$$

To get a representative sample, random sampling techniques were used. A list of all the villages in the Ngorongoro division constituting the NCAA was prepared to form villages sampling frame. In the village sampling frame, ten (10) villages were randomly selected. A list of heads of household in the randomly selected villages formed village respondents sampling frame. In the first nine (9) randomly selected villages, 14 respondents were selected from the established villages whereas from the last randomly selected village sampling frame only 13 respondents were randomly selected, hence making 139 randomly selected respondents for this study.

3.5 Data Collection Tools

During data collection, this study used a questionnaire survey to collect quantitative data. The questionnaire was directly administered with the respondents in their natural setting by the interviewer. A checklist was used to collect qualitative data. This guideline helped in asking key informants questions during focus group discussions.

3.6 Sampling Units

Data were collected from the heads of the household who were selected randomly from the Ngorongoro Division, Ngorongoro District in Arusha region. The study collected its data in June 2019.

3.7 Data Analysis and Interpretation Methods

In this study, a quantitative data analysis approach was used to collect using a questionnaire. After data collection, all the data was coded ready for data analysis using the IBM Statistical Package and Service Solutions (SPSS) version 20.0, a computer programme. To have a comparison of variables, descriptive statistics such as percentages, chi-square, and frequencies were used to describe the study population. Data from focus group discussions were analysed using a tabular sheet, summarised and presented in the study report complementing the findings due to quantitative data collection methodology.

3.8 Data Validity and Reliability

To ensure data validity issues of content and face validity was considered (Bolarinwa, 2015). Questions that were prepared for this study in the questionnaire were designed and structured to ensure they met the content validity requirements. According to Radhakrishn (2007), face validity requires the questionnaire to go through the hands of experts familiar with the nature of the study for them to assess the validity of the research instrument. Thus, before pre-testing of the questionnaire, it was given to experts in the environment management field. To deal with criterion-related issues, direct observation of behaviours of the respondents during data collection, this study

ensured that the respondents were randomly selected from the broadly defined population to represent the study group (Reis & Judd, 2000, p 10). As documented by on Ary *et al.* (2010), the sample size for use in the study was large enough for the generalisation of finding to the target population to be valid.

CHAPTER FOUR

FINDINGS AND DISCUSSION

4.1 Introduction

This chapter presents the study findings and discussions on the human-wildlife conflicts in the NCA and the community perception of the trends of human-wildlife conflicts for the past 10 years in the NCA in addition to comparing the variables. Moreover, the chapter presents the findings on the community's opinions on the best mitigation measures for combating human-wildlife conflicts in the Ngorongoro Conservation Authority explored in this study.

4.2 Types of Human-Wildlife Conflicts in the NCA

During this study, when the respondents were asked to indicate whether there was any prevailing Human-Wildlife Conflict (HWC) in the study area, all of them (100%) affirmed the existence of the conflict. And when they were asked about the most prevailing HWC in the area, they cited wildlife confronting humans (95.7%) of all the responses. Only 4.3 percent of all the respondents indicated the type of conflict to be human confronting wildlife, as Table 4.1 illustrates:

Table 4.1: Most Prevailing HWC in the Area

Respondents' choices	Respondents	Percentage
Wildlife confronting Humans	133	95.7
Humans confronting wildlife	6	4.3
Total	139	100.0

Source: Field Data (2019)

To explore the type of wild animal that attack human beings, the respondents were asked to cite cases of HWC in which wildlife confronted humans and to indicate the main types of conflicts. The result shows that the cases of wild animals attacking livestock was higher (66.9%) than those of wild animals attacking humans (33.1%). When respondents were asked to indicate the most prevalent among the wild animals that attacked human, they cited buffaloes (31.7%) followed by elephant (26.6%) and the leopards (22.3%), hyenas (17.3%). The least was the lion (2.2%). Figure 4.1 presents the result:

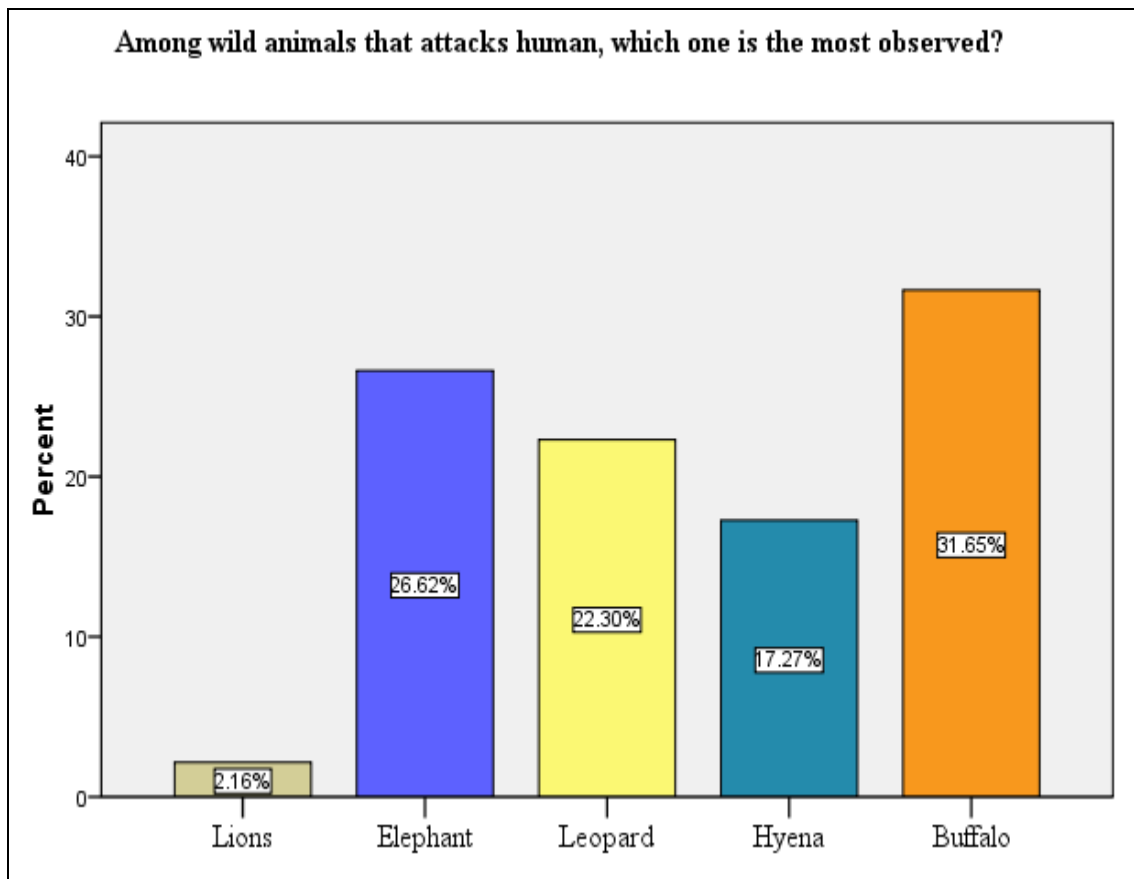


Figure 4.1: Wild Animals that Mostly Attack Human Beings

Source: Field Data (2019)

During the focus group discussions, participants were asked to explain why buffaloes were the wildest and most attacking minded animals against human beings in the

NCA when the same animals were mostly observed around NCA headquarter offices to be the most peaceful. The FGD participants pointed out that wild animals that were not exposed to harassment like those found around NCAA headquarters exhibited least hostile conduct against humans but usually buffaloes were dangerous. In this regard, Nareyo ole Kiranja said:

Buffaloes are dangerous animals to human beings. Unlike other wild animals, when buffaloes hear human voices in a certain direction, they move close to the path where the human beings would pass and abruptly attack them. We have a lot of cases of human beings being hurt and even killed by buffalo.



Figure 4.2: Buffaloes Found in the Vicinity of NCAA Offices are Less Hostile

To explore the most affected livestock by wild animals, the respondents were asked to indicate which among livestock attacked by wild animals were mostly affected. The results show that the sheep (36%) and goats (35%) were the most affected followed by cattle (20%). The least affected were donkeys (3%) as Figure 4.3 illustrates:

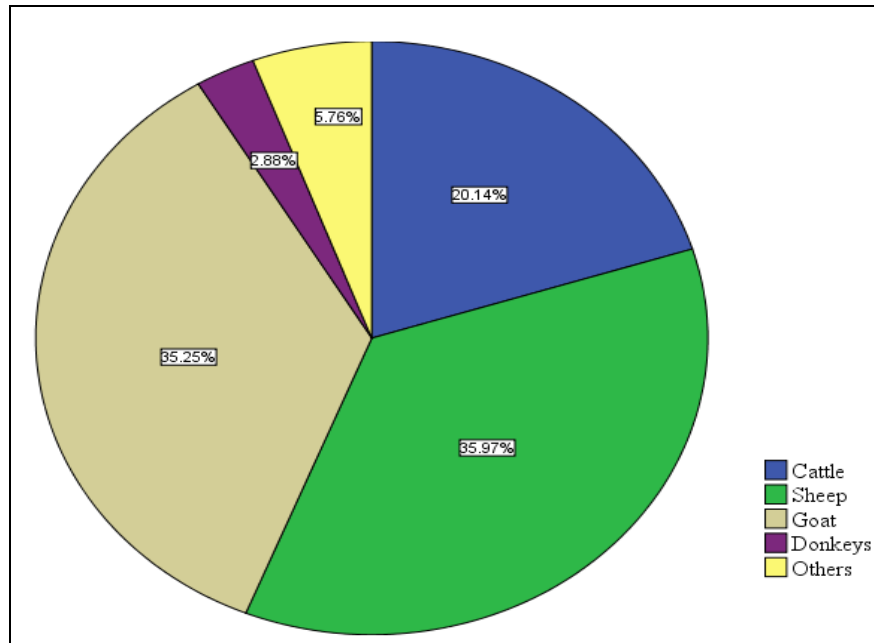


Figure 4.3: Livestock most affected by Wild Animals

Source: Field Data (2019)

The respondents were asked to indicate which wild animals attacked livestock, which ones were the most reported. The results show that hyenas accounted for the largest proportion (46%) followed by lions (33.1%), leopards (14.4%), and cheetahs (4.3%). Other wild animals that attacked livestock accounted for a negligible proportion of 2.2 percent, as Table 4.2 illustrates:

Table 4.2: Wild Animals Mostly Attacking Livestock

Respondents' choices	Respondents	Percentage
Lion	46	33.1
Cheetah	6	4.3
Leopard	20	14.4
Hyenas	64	46.0
Others	3	2.2
Total	139	100.0

Source: Filed Data (2019)

During FGDs, research participants indicated that in addition to wild animals infamous for attacking livestock (hyenas, lions, leopards, and cheetahs), animals such as baboons, jackals, and buffaloes also pose a threat to domesticated animals. They indicated that the lambs and kids were primary targets for baboons and jackals. In some cases, buffaloes fought cattle to the point that may hurt them. Regarding when the livestock were attacked, the respondents indicated that the wild animals occurred mostly at night (54.7%) as opposed to during the day (45.3%). During FGDs, the participants noted that most cases occurred late in the evening and early hours of the morning. During the late evenings, when livestock were heading back home, the most vulnerable livestock were reported to be those lost on the way or those trailing behind.

Table 4.3 presents these results:

Table 4.3: Time when Livestock are attacked Mostly by Wild Animals

Respondents' choices	Respondents	Percentage
During daytime	63	45.3
During night-time	76	54.7
Total	139	100.0

Source: Field Data (2019)

The study further explored which wild animals attacked livestock mostly during the day and that lion (32.4%) emerged tops followed by leopards (28.9%), hyenas (28.1%), and jackals (10.8%). Table 4.4 presents the results:

Table 4.4: Wild animals Attacking Livestock Mostly during the Day

Respondents' choices	Respondents	Percentage
Lion	45	32.4
Jackal	15	10.8
Leopards	40	28.8
Hyenas	39	28.1
Total	139	100.0

Source: This study 2019

When the respondents were asked to indicate which wild animals attacked livestock mostly during the night, their responses indicate that hyenas (46.0%) topped the chart, followed by leopard (30.2%), and lions (23.0%), as Table 4.5 illustrates:

Table 4.5: Wild Animals Attacking Livestock Mostly at Night

Respondents' choices	Respondents	Percentage
Lions	32	23.0
Leopards	42	30.2
Hyenas	64	46.0
Others	1	.7
Total	139	100.0

Source: Field Data (2019)

4.2.1 Causes of Human-Wildlife Conflicts in the NCAA

During the study, the respondents were also asked to indicate the causes of HWC. The leading reason cited by the respondents was competition over resources (33.1%) followed by change in human behaviours (20.1%), change in wild animals behaviours (19.4%), and native traditions (11.5%). Figure 4.4 presents the results:

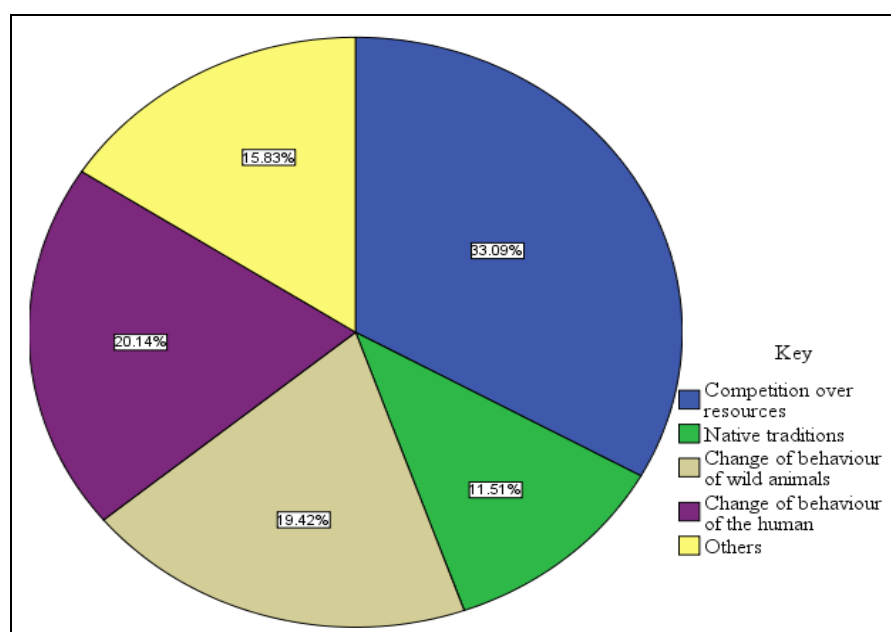


Figure 4.4: Causes of HWC in the NCAA

Source: Field Data (2019)

During the FGDs, the research participants indicated an increase in the population for both humans and wild animals, which contributed to the escalation of HWC in the study area. They reported that the increase in the population prompted the invasion of wildlife habitats. In this regard, Linus Ole Namjogo noted:

Most cases due to leopards attacking livestock grazing in areas hitherto reserved for wild animals in the forest, following the current increase in human and livestock population. People have built their houses in areas where we are meant to provide pasture, hence the grazing land is diminishing, causing the invasion of areas that used to be habitats for wild animals.

Exploring further how native traditions escalated the HWC, the study found that youth killing lions accounted for 42.4 percent, youth killing birds for 24.5 percent whereas others accounted for 33.1 percent, as Table 4.6 illustrates:

Table 4.6: HWC Caused by Native Traditions

Respondents' choices	Respondent	Percentage
Youth killing lions	59	42.4
Youth killing birds	34	24.5
Others	46	33.1
Total	139	100.0

Source: Field Data (2019)

During the focus group discussions, the research participants indicated that the traditions of youth killing either lion or birds are diminishing. In the past, killing the former occurred when lions attacked livestock. Nowadays, however, youth killed lion for the sake of traditions only. Concerning feathers worn during the circumcision period, Tokore ole Kishau said:

Due to punishment imposed to causalities found guilty of killing wild animals including birds, youth usually collects feather shaded by

ostriches in bushes. In a few cases, colourful birds [he named them – barbet] can be killed. But generally, people have been educating youth to abandon the tradition of killing animals.

Examining further the causes of conflict, respondents were asked to indicate the most prevailing cause of HWC instigated by the change of behaviour of wild animals. The results show that sick carnivores accounted for the largest proportion (47.5%) followed by injured wild animals, lactating wild animals (15.4%), old carnivores (8.6%) and others (5.8%), as shown in Figure 4.5.

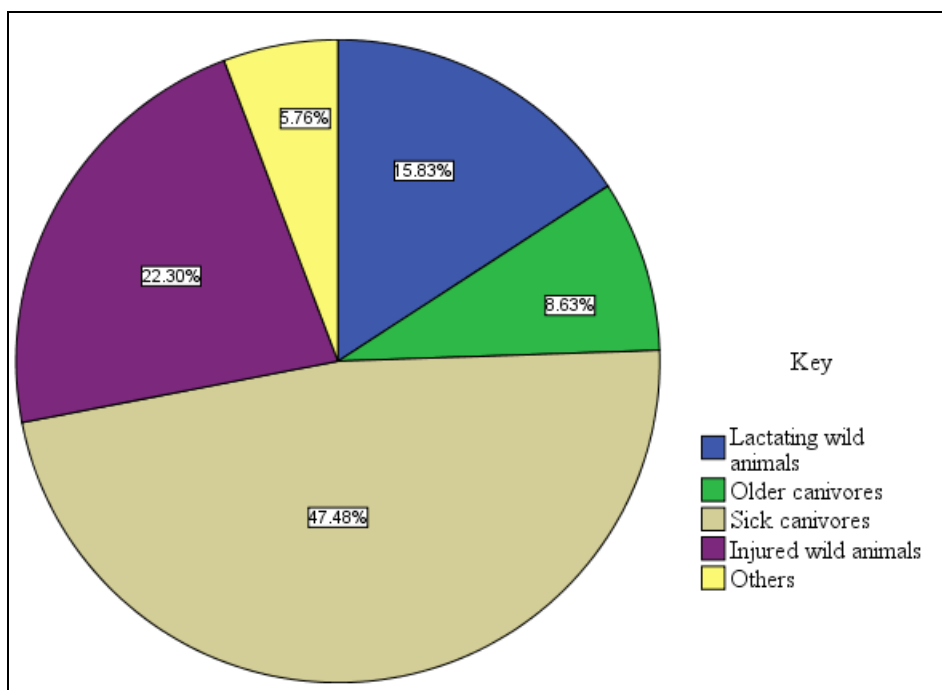


Figure 4.5: Most Dangerous Wild Animals Due to Change in Behaviour

Source: This study, 2019

During the FGDs, the research participants identified sick wild carnivores, particularly those suspected of suffering from rabies, as threats. They reported that cases of rabid hyenas and jackals attacking livestock were experienced in the Ngorongoro Conservation Area. They pointed out that since rabies is a zoonotic disease, it was

possible for transmission to occur from sick wild carnivores to domestic carnivores, particularly dogs, and vice-versa, hence compounding the human-wildlife conflict in the study area. Respondents were also asked to indicate which among HWC caused by change in human behaviour was the most prevalent in the study area. The results show that poor treatment of the natives by the NCA authority topped the chart of responses (26.6%), followed by the belief that there is a low native benefit accruing from conserving wildlife (25.9%). Table 4.7 presents the results:

Table 4.7: HWC Caused by Change in Human Behaviour

Respondents' choices	Respondents	Percent
Persistence in compensation delays	17	12.2
Low compensation packages	25	18.0
Assumed poor native benefits accruing from conserving wildlife	36	25.9
Poor native treatment by the NCA authority	37	26.6
Others	24	17.3
Total	139	100.0

Source: Filed Data (2019)

4.2.2 Community Perception on the Trends of HWC in the NCA

To establish whether HWC has increased in the past 10 years respondents were asked to give their views on this aspect. The results show that 33.1 percent moderately disagreed with the statement whereas 33.8 percent strongly agreed with it, 17.3 percent agree and 15.8 percent moderately agreed. Table 4.8 presents the results:

Table 4.8: Level of HWC Increment

Respondents' choices	Respondents	Percentage
Moderately disagree	46	33.1
Agree	24	17.3
Moderately agree	22	15.8
Strongly agree	47	33.8
Total	139	100.0

During FGDs, research participants pointed out that they were the untold story of the level of HWC in the study area. One research participant expressed doubt on whether the NCAA residents were not killing wild carnivores in revenge. In this regard, Namelock Ole Nangisha said:

I do not know whether a study has been done to compare the availability of wild carnivores in the vicinity of native residents bomas [dwellings] and that found far from residents with high protection like in the Ngorongoro crater. I think more carnivores will be found far from bomas, hence indicating an increase in HWC.

When the respondents were asked to give their opinion on whether natives in the NCA were becoming less tolerant of wild animals due to HWC, the results that about 32.4 percent agreed with the statement, 28.8 percent moderately did so whereas 28.1 percent moderately disagreed and 10.8% percent strongly disagreed. Table 4.9 presents the results:

Table 4.9: Natives are Becoming less Tolerance to Wild Animals to HWC

Respondents' choices	Respondents	Percent
Strongly disagree	15	10.8
Moderately disagree	39	28.1
Agree	45	32.4
Moderately agree	40	28.8
Total	139	100.0

When the respondents were asked about their views on whether the NCA had adequately addressed HWC, the results show that about 33.8 percent strongly agreed with the statement, 22.3 percent moderately disagreed whereas 26.6 percent agreed, and 17.3 percent moderately agreed with the statement. Figure 4.6 presents the results:

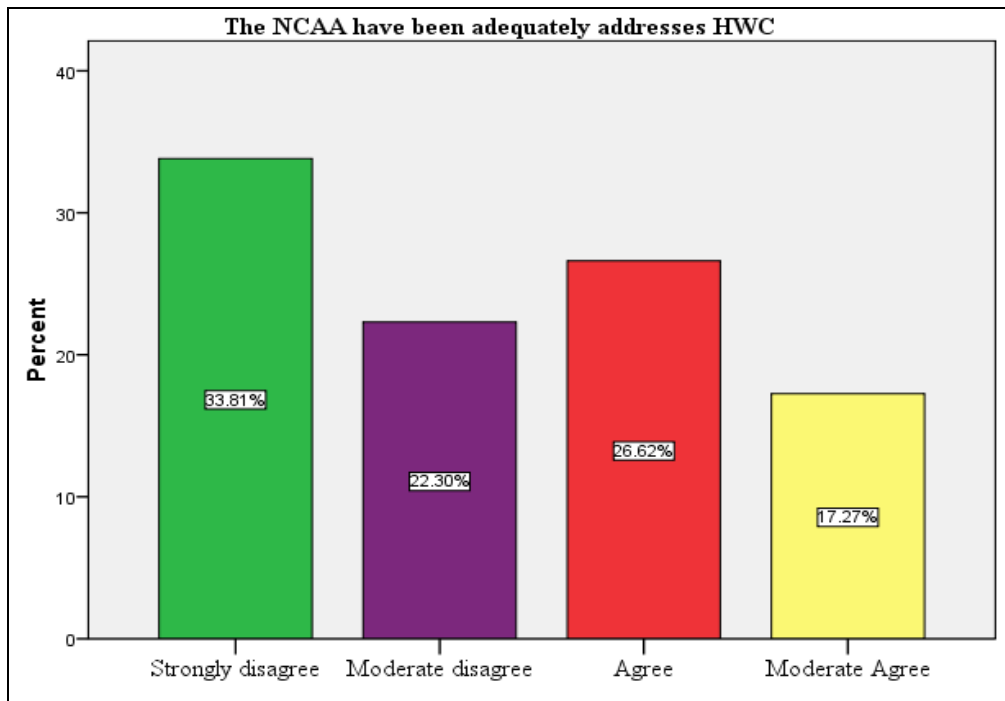


Figure 4.6: NCAA has been Adequately Addressed HWC

As a means for double-dipping on the existence of native tradition in lion killing, respondents reported that 49.6 percent strongly disagreed with the statement, 44.6 percent moderately disagreed with it and 5.8 percent moderately agreed with the statement, Table 4.10 presents the results

Table 4.10: Level of Native Youth Tradition of killing lions has Increased

Respondents' choices	Respondents	Percentage
Strongly disagree	69	49.6
Moderately disagree	62	44.6
Moderately agree	8	5.8
Total	139	100.0

The respondents were asked to provide their views on whether more mechanisms of reducing HWC are being devised. Responding, 39.6 percent moderately agreed with

the statement, 23 percent strongly agreed, 15.8 percent simply agreed, 10.8 percent moderately agreed and a similar percentage (10.4%) strongly agreed with the statement. Figure 4.7 presents the results:

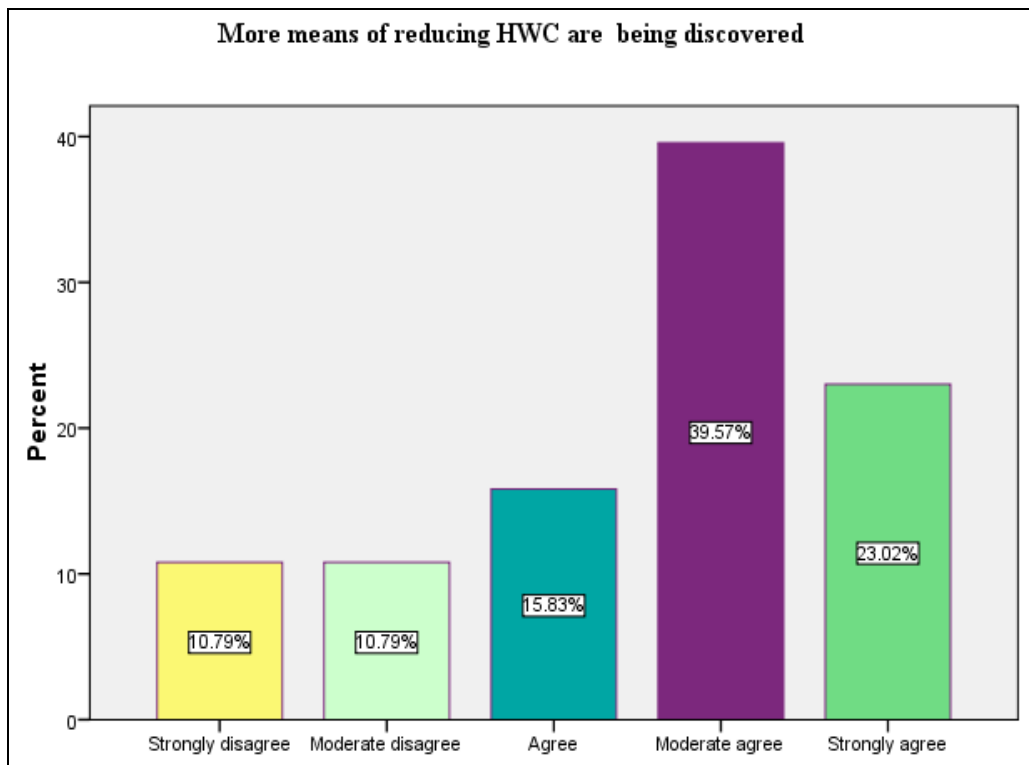


Figure 4.7: Devising More Mechanisms for Reducing HWC

During the FGDs, research participants revealed that the mechanism for reducing HWC that have been instituted in the past 10 include the construction of strong bomas using poles instead of tree branches that are easily destroyed by wild animals to get access to livestock and avoiding using children in herding livestock in areas of high risk of attack by wild animals. They said that the presence of Mama Simba (a recent lion conservation project in the area) has served as a means for discouraging lion killing because the community would be awarded when lion numbers increase in their area.

Kipilangat Ole Siteo said:

Although the NCAA discourages wanton cutting of trees, nowadays residents have been using strong poles in constructing bomas for fencing their livestock off as these have been found to be strong enough to prevent wild animals such as hyenas from preying on livestock at night.

During the FGDs, it emerged that the NCAA had introduced natives wildlife conservation motivation schemes for undertaking communal development projects such as building schools and supporting individual students, and providing safe and clean water. When respondents were asked to indicate whether the gravity of HWC was more serious than documented, 26.6 percent moderately disagreed with the statement, 23. percent strongly agreed, 22.3 percent strongly disagreed, 16.5 percent agreed and 11.5 percent moderately agreed with the statement, as Table 4.11:

Table 4.11: Gravity of HWC Bigger than Documented

Respondents' choices	Respondents	Percentage
Strongly disagree	31	22.3
Moderately disagree	37	26.6
Agree	23	16.5
Moderately agree	16	11.5
Strongly agree	32	23.0
Total	139	100.0

Issues of genuine community participation in addressing HWC are paramount for sustainable conservation. When respondents were asked to indicate whether the community has been adequately involved in addressing HWC in the NCAA it was found that opinions varied. Some 38.8 percent of the respondents agreed with the

statement whereas 28.8 percent strongly disagreed and 21.6 percent moderately disagree, as Table 4.12 demonstrates:

Table 4.12: Adequate Community Involvement in Addressing HWC in NCAA

Respondents' choices	Respondents	Percentage
Strongly disagree	40	28.8
Moderately disagree	30	21.6
Agree	54	38.8
Moderately Agree	8	5.8
Strongly agree	7	5.0
Total	139	100.0

Additionally, the study respondents were asked to indicate whether cases of retaliatory killing of wild animals in the NCAA in the past had increased. The results found that 31.7 percent strongly disagreed with the statement, 28.8 percent moderately disagreed, 22.3 percent agree whereas 11.5 percent moderately agree and 5.8 percent strongly agree. Table 4.13 illustrates the results:

Table 4.13: Cases of Retaliatory Killing of Wild Animals in the NCAA Increasing

Respondents' choices	Respondents	Percentage
Strongly disagree	44	31.7
Moderately disagree	40	28.8
Agree	31	22.3
Moderately agree	16	11.5
Strongly agree	8	5.8
Total	139	100.0

With regard to whether the laws are more in favour of wildlife than native inhabitants, hence fuelling HWC it was found that most of them (66.9%) strongly agreed with the statement, followed by agreed (16.5%), moderately disagreed (10.8%) and the least

being those whose opinion follow under moderately agreed (5.8%). Table 4.14 presents the results:

Table 4.14: Laws Favours Wildlife More than Native Inhabitants Fuel HWC

Respondents' choices	Respondents	Percentage
Moderately disagree	15	10.8
Agree	23	16.5
Moderately agree	8	5.8
Strongly agree	93	66.9
Total	139	100.0

4.2.3 Mitigation Measures for Combating Human-Wildlife Conflicts in the NCAA

To explore the best mitigation measures for combating the human-wildlife conflict, the respondents were asked several questions. On whether the provision of conservation knowledge to natives is the best way for combating human-wildlife conflict in NCAA, the results that 48.9 percent strongly agreed, 39.6 percent simply agreed, 5.8 percent moderately agreed, and 5.8 percent moderately disagreed. Table 4.15 presents the results in tabular form:

Table 4.15: Provision of Conservation Knowledge on Best Way of Fighting NCAA

Respondents' choices	Respondents	Percent
Moderately disagree	8	5.8
Agree	55	39.6
Moderately agree	8	5.8
Strongly agree	68	48.9
Total	139	100.0

The respondents were also asked to indicate whether the provision of timely compensation was the best way of fighting HWC in the NCAA. Responding, 39.6 percent agreed, 33.1 percent strongly agreed, 21.6 percent moderate agreed and 5.8moderately disagreed with the statement on timely compensation, as Table 4.16 illustrates:

Table 4.16: Provision of Timely Compensation as Best Way of Combating HWC

Respondents' choices	Respondents	Percent
Moderately disagree	8	5.8
Agree	55	39.6
Moderately agree	30	21.6
Strongly agree	46	33.1
Total	139	100.0

When respondents Furthermore, the respondents were asked to indicate whether they use solar lighting was one of the best ways of combating HWC in the NCAA. The results show that 46 percent moderately agreed, 25.9 percent strongly agreed, 17.3 percent moderately agreed and 5.8 percent moderately disagreed with the statement use of solar lighting as deterrence against wildlife incursion. Table 4.17 presents the results:

Table 4.17: Use of Solar Lighting as the Best Way of Combating HWC

Respondents' choices	Respondents	Percentage
Strongly disagree	8	5.8
Moderately disagree	24	17.3
Agree	7	5.0
Moderately agree	64	46.0
Strongly agree	36	25.9
Total	139	100.0

During the focus group discussions, the research participants pointed out that initially they had used solar lighting at the beginning it works but afterwards wild-animals got used to it so much that it no longer helps in repelling the wild animal at night as originally intended.

Also, the respondents were asked to indicate whether they use of strong fences around their bomas constituted the best means of combating HWC in the NCAA. The results show that 43.9 percent strongly agreed, 28.1 percent moderate agreed, 22.3percent agreed and 5.8 percent moderately disagreed. Table 4.18 presents the results:

Table 4.18: Use of Strong Fences as Best Means for Combating HWC in NCAA

Respondents' choices	Respondents	Percentage
Moderately disagree	8	5.8
Agree	31	22.3
Moderately agree	39	28.1
Strongly agree	61	43.9
Total	139	100.0

On whether participatory handling of cases related to WHC as the best means for fighting HWC in the NCAA, 44.6 percent of the respondents agreed, 28.1percent others moderately agreed, and 27.3 percent strongly agreed, as Table 4.19 illustrates:

Table 4.19: Participatory Handling of Cases as the best Means of Fighting HWC

Respondents' choices	Respondents	Percentage
Agree	62	44.6
Moderately agree	39	28.1
Strongly agree	38	27.3
Total	139	100.0

Regarding whether the provision of artificial feathers for youth during circumcision period can reduce HWC related to bird killing, the results show that 33.8 percent of the respondents strongly disagreed, 28.1 percent others strongly disagreed, 27.3 percent simply agreed, 5.8 percent moderate disagree, and 5.0 percent strongly agreed.

Table 4.20 details the results:

Table 4.20: Provision of Artificial Feathers can Reduce HWC related to Bird Killing

Respondents' choices	Respondents	Percentage
Strongly disagree	39	28.1
Moderately disagree	47	33.8
Agree	38	27.3
Moderately agree	8	5.8
Strongly agree	7	5.0
Total	139	100.0

The study also solicited responses on whether the provision of sports and games to youth during circumcision period could reduce their engagement in the traditional killing of wildlife. Responding, 44.6 percent of the respondents moderately disagreed, 28.1 percent others simply agreed, 15.8 percent strongly agreed and 11.5 percent moderately agreed with the statement on sports and games mitigating wildlife killings by youth. Table 4.21 presents the results:

Table 4.21: Provision of Sports and Games can Reduce HWC in NCAA

Respondents' choices	Respondents	Percentage
Moderately disagree	62	44.6
Agree	39	28.1
Moderately agree	16	11.5
Strongly agree	22	15.8
Total	139	100.0

Also, the study sought to establish whether controlling the number of livestock could help reduce HWC in the area. The results show that 37.4 percent of the respondents strongly disagreed, 34.5 percent others agreed, 17.3 percent moderately disagreed, and 10.8 percent strongly agreed with the statement on controlling number of herds as a mitigating measure. Table 4.22 details the results:

Table 4.22: Controlling Number of Livestock as Measure for Reducing HWC

Respondents' choices	Respondents	Percent
Strongly disagree	52	37.4
Moderately disagree	24	17.3
Agree	48	34.5
Strongly agree	15	10.8
Total	139	100.0

Furthermore, the study sought to determine whether the reduction of wild carnivores in the NCA via relocation to other areas could reduce HWC in the area. The results show that 43.2 percent of the respondents strongly disagreed, 23.0 percent others moderately agreed, 16.5 percent agreed, 11.5 percent moderately disagree and 5.8 percent strongly agreed with statement on relocating wild carnivores reducing human-animal conflict. Table 4.23 presents the results:

Table 4.23: Reduction of Wild Carnivores Can Reduce HWC

Respondents' choices	Respondents	Percent
Strongly disagree	60	43.2
Moderately disagree	16	11.5
Agree	23	16.5
Moderately agree	32	23.0
Strongly agree	8	5.8
Total	139	100.0

The study also asked respondents to indicate whether the laws available to deal with HWC in NCAA need amendment to reduce HWC in the area. The results show that 42.4 percent of the respondents strongly agreed, 28.8 percent others agreed, 23.0 percent moderately agreed, and 5.8 percent moderately disagreed with the statement on the need to amend the laws to deal with HWC. Table 4.24 presents the results:

Table 4.24: Available Laws on HWC for the NCAA Need Amendment

Respondents' choices	Respondents	Percentage
Moderately disagree	8	5.8
Agree	40	28.8
Moderately agree	32	23.0
Strongly agree	59	42.4
Total	139	100.0

4.3 Discussion

4.3.1 Types of Human-Wildlife Conflicts in the NCA

During this study, when respondents were asked to indicate whether there was any prevailing Human-Wildlife Conflict (HWC) in the study area, 100 percent of those who were interviewed confirmed such existence of the conflict. This finding is consistent with Billé *et al.* (2012) who found that the material conditions promoted human welfare while conserving biodiversity appear incompatible. According to Shemwetta and Kideghesho (2000), “Conflicts between wildlife and people” especially when “shar[ing] the same ecosystem” with those in “boundaries with protected areas” are a universal problem. Stanley *et al.* (2014) noted that conflicts between people and wildlife are main threats to conservation in Africa. However, Swanson (2007) noted that since its establishment, NCAA is meant for multiple land

use for people, livestock, and wildlife to co-exist with a high degree of HWC tolerance by the pastoralists.

When respondents were asked to account for HWC whereby wildlife confront humans, they indicated that cases of wild animals attacking livestock were higher (66.9%) than those of these beasts attacking humans (33.1%). Implicitly, the residents in the study areas did not only lose their livestock but also ended up being victims themselves. In this regard, the Wildlife Policy 1999 stipulates: “There is a necessity of controlling wildlife, which poses or cause damage to human life and property.” In other words, the wildlife-human conflict can be tolerable only to a certain extent.

When the respondents were asked to indicate which wild animals attacked humans mostly, the results show that the buffaloes featured much more prominently (31.7%) than others, followed by the elephants (26.6%), the leopards (22.3%), and the hyenas (17.3%). The least were lions (2.2%). This finding is consistent with Matindi *et al.* (2015) who documented that human-wildlife conflicts are prevalent, with large numbers of big mammals such as elephants, buffaloes, and lions still roaming freely in marginal rangelands and protected areas., The NCA is “endowed with a complex community of large grazing mammals accompanied by an equally impressive diversity of large and small predators including as many as 7,500 hyenas, 3,000 lions, 1,000 leopards, 225 cheetahs, and wild dogs,” according to the IUCN (2017).

This study found buffaloes to be the wildest animals that attacked humans in the NCA. On the other hand, animals observed mostly around the NCAA headquarters behaved less aggressively. Participants pointed out that those wild animals not

exposed to harassment like those found around NCAA headquarters exhibited tame behaviour but buffaloes were, usually, dangerous. However, it was not known whether buffaloes behaved in a tame or hostile manner was due to the impact of human interaction with wildlife. In this regard, Patana *et al.* (2018) observed:

An impact, positive or negative, is the result of a wildlife-related event that causes a human reaction and results in human behaviour. The author noted that both the human reaction to an event (positive versus negative) and the resulting behaviour from an impact affect wildlife and are influenced by complex interactions among humans.

In other words, the human-wildlife interaction in such scenarios remain rather complex, and need carefully planned and executed intervention measures.

4.3.2 Causes of Human-Wildlife Conflicts in the NCAA

During the study, respondents were asked about the causes of HWC. The results showed that most of the responses indicated competition over resources (33.1%) to lead the causes of HWC in the study area. The other causes are change in human behaviour (20.1%), change in the behaviour of wild animals (19.4%). In the meantime, native traditions accounted for 11.5 percent. As Biru *et al.* (2017) contended, “For a long period generally pastoralists have been living in harmony with wild animals.” Similarly, Niamir-Fuller *et al.* (2012) proffer: “Pastoralists believe that livestock has to live in co-existence such that either of them can live alone.” Peterson *et al.* (2010), on their part explain this dilemma thusly:

Although the conservation benefits of the terministic shift are debatable, a major shift occurred, nonetheless. Terministic screens become problematic in biodiversity conservation contexts when they frame the needs of humans and wildlife as arising from conscious antagonism. Cases, where the resource demands of humans and wildlife must be balanced, could be described as human-wildlife coexistence, human-wildlife competition, or human-human conflict.

Chardonnet *et al.* (2010) also noted that the fast “encroachment of human activities on lion habitat – the reduction of wilderness as a whole – increases the interface between humans and lion”. This development, consequently, makes coexistence of large predators such as lion with humans, their potential prey, rather difficult. During focus group discussions research participants indicated a rise in the population for both humans and animals to contribute towards the escalation of HWC in the study area. According to Swanson (2007, p.15), the human population explosion in Ngorongoro Conservation Area from 1959 when the conservation was incepted (p 15).

According to the NCA (2013), the human population in the NCA swelled from 26,743 in 1988 to 87,851 in 2012, a 5.6 percent human population increase. The conflicts, then, are in this small area grow as wildlife and the Maasai livestock compete for valuable resources crucial to their survival (Swanson, 2007). As such, the increase in both human beings and livestock threatened the existence of wildlife conservation in the NCA as per its establishment, hence leading to zoning of the area, which restricts accessibility for pastoralists in some areas including the Ngorongoro crater and reams of the Embakai crater. Native pastoralists treated perceived these restrictions as a threat to their livestock keeping, hence igniting human-wildlife conflict.

Exploring how the indigenous people’s traditions escalated HWC, the study found that youth killing of lions accounted for 42.4 percent and killing of birds stood at 24.5 percent. Meanwhile, other youthful killings accounted for 33.1 percent. Traditionally, at a certain age, youths are obliged to participate in hunting some wild animals as part of ceremonial deeds (Gardner, 2016; Tian, 2016). At 14 years, Maasai youth undergo

circumcisions that accompanied by making of crowns using birds' feathers (Hodgson, 2001; Bruner & Kirshenblatt Gimblett, 1994).

During the FGDs, research participants hinted that the tradition of youth killing either lions or birds was diminishing. It is mostly observed that retaliatory cases occurred when lions attacked livestock. However, nowadays it was difficult to observe youths killing lions only for the sake of fulfilling traditions. According to Ikanda and Packer (2008, p. 72), the Maasai tend to kill lions in "retaliation for livestock depredation" in the pastoralist NCA. Additionally, though the short grass plains serve as ritual hunting grounds", Maasai warriors tend to kill nomadic Serengeti lions during the wet season. Based on the study by Ikanda and Packer (2008), it was difficult to get information on cases related to Maasai killing of lions in the NCAA as part of their tradition. They illustrate using a case of a group of Maasai that had just speared a radio-collared Serengeti female and claimed that it was a retaliatory attack as the feline creature had mauled cattle 30 km away the previous day. Yet, the radio-collared lion could not have killed their livestock, and neither had this group of Maasai travelled 30 km overnight (Ikanda & Packer, 2008, p. 72).

To explore more on the causes of conflict, the respondents were asked to state what, among those HWC caused by the change of behaviour of wild animals, was the most compelling in this area. In their responses, it was noted that sick carnivores accounted for the largest proportion (47.5%) followed by injured wild animals, lactating wild animals (15.4%), old carnivores (8.6%) and others (5.8%). During the FGDs, research participants cited sick wild carnivores as a threat particularly those suffering from rabies. They said that cases of rabid hyenas and jackals attacking livestock were

experienced in the Ngorongoro Conservation Area. They pointed out that since rabies is a zoonotic disease it was possible for transmission from ailing wild carnivores to domestic carnivores, particularly dogs and vice-versa, hence escalating the human-wildlife conflict in the study area.

4.3.3 Community Perception on the Trends of HWC in the NCA

The study also explored whether HWC had increased in the past 10 years. Responding, 33.1 percent of the respondents moderately disagreed whereas 33.8 percent showed strongly agreed with the statement. In this regard, a study by Ikanda and Packer (2008) indicated that wildlife killing at the hands the Maasai in the study area was little documented. As Gardner (2016) and Tian (2016) noted, ceremonial wildlife killing persisted, hence signalling the prevalence of HWC.

This study established that they are the untold story of the level of HWC in the study area. One research participant expressed doubt on whether the NCAA residents were not killing wild carnivores in retaliatory scenarios in an unreported manner. As noted earlier, Ikanda and Packer (2008) contend that it was difficult to get information on cases related to the Maasai killings of lions in the NCAA to fulfil traditional demands. To a certain degree, residents did not tolerate HWC in the study area. In fact, a considerable number of respondents confirmed the presence of less tolerance with HWC is worth. According to Swanson (2007), “Although Maasai pastoralists in the NCA exerted a high degree of tolerance with livestock predation by wildlife, the conflict among the two do exist and that unsolved HWC threatens the sustainability of the wildlife conservation as per NCAA establishment in 1959.”

As a means of double-dipping on the existence of native traditions of lion killing, when respondents were asked for their opinion on whether the level of native youth traditions of killing lions had increased. The results show that about 49.6 percent strongly disagreed with the statement, 44.6 percent moderately disagreed and 5.8 percent moderately agreed with it. Different scholars (see, for example, Gardner, 2016; Tian, 2016) have established that at a certain age Maasai youths participate in hunting wild animals as part of the rite of passage.

The study has also established that more means of reducing HWC had devised for the past 10 years. In fact, the NCAA has undertaken various projects to reduce HWC to motivate indigenous peoples in fostering wildlife protection. Moreover, the NCAA has introduced natives' wildlife conservation motivation schemes by undertaking communal development projects such as building schools and supporting individual students, as well as provision of safe and clean water.

Means for reducing HWC that have been instituted include the construction of strong bomas using poles instead of tree branches that are easily destroyed by wild animals to maraud on livestock. They said that the presence of Mama Simba (a recent lion conservation project in the area) has served as a means for discouraging lion killing as the community get rewarded when the population of lions increase in their area. According to Elmqvist *et al.*, (2010), the interactions in the communities of organisms at the population and community level do play a significant role in determining the stability and resilience of the ecosystem in place. Thus, the provision of community education on conservation at all levels has reduced HWC in the study area.

Also, issues of genuine community participation in addressing HWC are paramount for sustainable conservation. When respondents were asked to indicate whether the community had been adequately involved in addressing HWC in the NCAA it emerged that opinions varied. About 38.8 percent of the respondents agreed with the statement whereas 28.8 percent strongly disagreed and 21.6 percent moderately disagreed with it. This result is contrary to the Wildlife Policy of 1999 that recognises the need for changing how wildlife resources are managed and conserved in addition to promoting local community participation in conserving and utilising wildlife resources.

When the respondents were asked to indicate whether the laws in place favour wildlife at the expense of native inhabitants, hence fuelling HWC, the study found that most of them (66.9%) strongly agreed with the statement, some agreed (16.5%), others (10.8%) moderately disagreed with and the least (5.8%) moderately agreed with the statement. Peterson *et al.* (2010) insist on all human experience being grounded in material reality, as “materiality alone is insufficient to motivate social action”. As such, people's experiences, beliefs, and values tend to frame their perceptions. In this regard, when the NCAA residents perceive the laws in place to favour wildlife, then they were likely to be silent on human killing of wildlife.

4.3.4 Mitigation Measures for Combating Human-Wildlife Conflicts

There are two basic approaches to managing human-wildlife conflicts: Prevention and mitigation (Muruthi, 2005). Preventive measures can prevent or ease the risk of conflicts stemming from people and animals and include the extreme one of completely removing either the people or the animals, physically separating the two

using barriers, and deploying a variety of scaring and repelling techniques. During this study, when respondents were asked to ponder over whether the provision of conservation knowledge to natives is the best way of combating NCAA. Most of them (48.9%) agreed strongly agreed, 39.6 percent agreed, 5.8 percent moderately agreed and 5.8 percent moderately disagreed. The provision of conservation education to NCA residents would be part of prevention measures as recommended by Muruthi (2005). According to FAO (2010), preventing the happening of HWC, the first step is to raise people's consciousness that they were in a wildlife area and of the potential consequences.

When respondents were asked to indicate whether the provision of timely compensation is the best way of dealing with HWC in the NCAA. The study established that, 39.6 percent agreed, 33.1 percent strongly agreed, 21.6 percent moderate agreed and 5.8 percent moderately disagreed with the statement. According to Chardonnet *et al.* (2010), uncontrolled remote areas where wildlife damage occurs, the victims tend to seek compensation a to recover payment for the losses. Yet, compensation is not a priority means for dealing with HWC in the NCAA (Swanson, 2007), The place has been established for multiple land use, hence allowing humans, their livestock, and wildlife to co-exist in the same area.

When the respondents were asked to indicate whether they used of solar light to combat HWC in the NCAA, 46.0 percent of them moderately agreed, 25.9 percent strongly agreed, 17.3 percent moderately agree and 5.8 percent moderated disagree with the statements. This finding is consistent with Manoa and Mwaura (2016) who noted:

Deterrent solar lights, which are installed around pastoralist bomas, prevent predators from entering the boma during the night and raid the livestock. However, the effectiveness of retaliating light works in the first days of installation in the area. During the focus group discussion, research participants pointed out that initially the use of retaliating light at the beginning worked but afterwards wild-animals got used to them to the point that it does not help in repelling the wild animal during the night.

When the respondents were asked whether they use strong fences around the bomas is the best means of combating HWC in the NCAA it was established that most of the respondents (43.9%) strongly agreed, and 28.1 percent moderately agreed. This supports Chardonnet *et al.* (2010) who indicated that “the best way to avoid conflict with lions is through lion-proof *bomas*. When I say ‘lion-proof’, I mean *bomas* which are sufficiently high and strong to prevent cattle from breaking out of them and lions from jumping in.”

When the respondents were asked to indicate whether participatory treatment of cases related to WHC is the best way of combating HWC in the NCAA, 44.6 percent of the respondents agreed, 28.1 percent moderately agreed, and 27.3 percent strongly agreed. This finding is consistent with The Wildlife Policy of 1999 that was formulated recognising the need for changing how wildlife resources are managed and conserved but must promote local community participation in conserving and utilising wildlife resources.

On whether the provision of sports and games to youth during the circumcision period could reduce chances for youth to engage in the traditional killing of wildlife, 44.6 percent moderately disagreed, 28.1 percent agreed, 15.8 percent strongly agreed and 11.5percent moderately agreed with the statement. According to Richardson *et al.*

(2017), the use of sport as an intervention to reduce crime in the community and prisons in recent years, and to reduce radicalization of young adults has become common. Studies suggest that participating in sport may improve self-esteem, enhance social bonds, and provide participants with a feeling of purpose. The introduction of an education element can improve outcomes following the completion of the programmes, providing participants with a pathway towards employment. Although it is recognised that sport may form only one element towards the reduction of crime and radicalisation, effectiveness, may be enhanced by a combination of other services such as religious re-education and assistance with housing.

When the respondents were asked whether control of the number of livestock in the best means for reducing HWC in the area, 37.4 percent of the respondents strongly disagreed, 34.5 percent agreed, 17.3 percent moderately disagreed, and 10.8 percent strongly agreed. The idea of reducing the livestock population may sound practical in reducing HWC. However, according to FAO (2010), preventing the occurrence of HWC, the first step is to raise people's awareness that they are in a wildlife area and of the potential consequences: living, working or travelling in areas with large carnivores calls for preparedness.

The same idea of dealing with a population of also wildlife was indicated to have effects in dealing with HWC. When respondents were asked on whether the reduction of wild carnivores in the NCA by relocation to other areas is the best means of reducing HWC in the area it was established that, 43.2 percent strongly disagrees, 23 percent moderately agreed, 16.5 percent agreed, 11.5 percent moderately disagree and 5.8 percent strongly agreed. However, it should be remembered that the NCA has

been established as multiple land use allowing humans, livestock, and wildlife to share the same ecosystem. The question is how much of each of the elements originally meant to use the areas is supposed to be maintained to maintain the purpose of its establishment.

When the respondents were asked to indicate whether the laws in place dealing with HWC for the NCAA have to be amended to ease HWC in the area it was found that 42.4 percent strongly agreed, 28.8 percent agreed, 23.0 percent moderately agreed, and 5.8 percent moderately disagreed. This indicates that NCA residents were not happy with the current governing laws that operate in the study area. In this regard, Kipuri *et al.* (2008) notes:

Under the NCA Ordinance, the NCAA is mandated to control all land use, commercial activity, entry, and residence within NCA. The author noted that, despite recognizing pastoralism as a sustainable land-use system, the NCAA has restricted pastoralist grazing and are excluded from prime grazing sites in various parts of NCA, and must get permits to take livestock to the Ngorongoro crater to access mineral salts.

This restriction tends to annoy the pastoralists and trigger the need to amend the laws currently in place.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

In this chapter one will find information on what this study has concluded and its recommendations based on findings. Also, one will find information on areas for further Research.

5.2 Conclusion

Based on the study findings, it is evident that HWC persists in the NCAA. Livestock is more prone to wild animal attack than human beings. Buffaloes were found to threaten human beings in addition to elephants, leopards, hyenas, and lions. The study also found that wild animals that were not exposed to human harassment like those found around the NCAA headquarters exhibited less aggressive behaviour than others. All the domestic animals found in NCAA (cattle, sheep, goats, donkeys, and domestic dogs) were preyed on by wild animals. Sheep and goats were mostly found to be victims of HWC with more cases at the hands of hyenas at night. Lion's predations are mostly observed early in the morning and in the late evening most victims being those livestock at the back when herding back home and those lost in the rangeland.

The study also found that human-wildlife conflict in the NCAA was mostly occasioned by competition over resources by both human beings, their livestock, and wild animals. In fact, the increase in the human population has resulted in the invasion of areas used mostly by wildlife. There was an observable threat in HWC due to the change of behaviour by wild animals when they are sick, especially rabid carnivores.

Injured wild animals exhibited abnormal aggression. Additionally, the NCA natives were not happy with the degree of participation in the HWC management in the area, hence the causing silent retaliation.

Although the Maasai pastoralists in the NCAA used to have a high degree of tolerance of livestock predation, silent retaliation against wild carnivores persists as in the past with little traditional killing of wild animals when compared to the past. In the meantime, more means of reducing HWC have been established including the use of strong fences around native bomas, as well as the introduction of zoning whereby the indigenous peoples were not allowed to graze their livestock in some areas such as the Ngorongoro crater preserved for wild animals. The NCAA has introduced native wildlife conservation motivation schemes entailing undertaking communal development projects such as building schools and supporting individual students, provision of safe and clean water. Some projects have been introduced on Livestock predation compensation schemes that focus on the existence of wild carnivores (lions) in the community rather than relying on the number of livestock predated.

The mitigation measures in place include inculcating conservation knowledge among the indigenous peoples, promoting livestock predation compensation schemes, advocating for building bomas using strong fences that are wildlife proof and implementing participatory retreatment of WHC cases. The provision of sports and games to youth could also reduce chances for practising traditional wild animal hunting. Also, livestock predation could be reduced when young children were not leave alone to tend for livestock in areas inhabited by dangerous wild animals.

5.3 Recommendations

The Ngorongoro Conservation Area Authority has been designed to serve as a multipurpose place for both wildlife and human beings to share the same ecosystem and thrive. In this regard, precautions must be taken by natives to avoid grazing their livestock in areas with a high degree of predation. To prevent their livestock from being killed at night, bomas should be strong enough to bar wild animals from attacking their livestock. Additionally, people should avoid herding their livestock early in the morning and late in the evening to reduce chances for their livestock being attacked by lions.

To reduce competition over resources in the NCAA, natives must be encouraged to practices diversification of enterprises particularly those with little competition with wild animals. Relevant authorities need to pay special attention to addressing issues of rabid carnivores in addition to minimising incidences that may end up with injuries to wild animals to reduce HWC due to sick and injured wild animals. In this regard, the NCAA must improve the relationships with natives by increasing their participation in dealing with HWC.

Overall, there are several means for reducing HWC that been evident in the past 10 years that have been applicable in the NCA. These approaches include the use of building poles to construct strong fences for preventing wild animals from entering the bomas. These have had negative effects on the environment. As such, the NCAA has to find an alternative to using poles while maintaining the idea of building strong fences around the bomas. Moreover, the residents of the study area need to promote

compensation schemes that focus on the availability of wild animals in the native's environment than relying on the number of livestock predated.

5.4 Areas for Further Research

- (i) The NCA has been established with the aim of ensuring that there is co-existence among human beings, their livestock and wildlife in a shared environment. Research in this regard, therefore, should establish the optimum population for human beings, livestock, and wild animals to co-exist without jeopardising the wellbeing of one another.
- (ii) As a retaliation has been reduced in the NCAA but with the relative population in the Ngorongoro crater higher than in the vicinity of natives' bomas, it is essential to study the differences in dispersal wildlife over the NCA area caused by retaliation by natives.
- (iii) Additionally, there is a need for a study on the best compensation mechanism capable of motivating conservation by natives while ensuring the NCA continued existence.

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APPENDICES

Appendices 1: Questionnaires

Section A: Types of human-wildlife conflicts in the NCA

1. Is there any prevailing Human-Wildlife Conflict (HWC) in this area?

Choose one.

1. Yes
 2. No
-
2. If Yes, what among the following is mostly prevailing HWC in this area?
 1. Wildlife confronting human
 2. Human confronting wildlife
-
3. Among those HWC whereby wildlife confront human what are the main type of conflict?
 1. Wild animal attacking human
 2. Wild animals attacking livestock
 3. Others, mention
-
4. Among wild animals that attack humans, which one is most observed?
 1. Lion
 2. Elephant

3. Leopards
 4. Hyenas
 5. Buffaloes
5. Among wild animals that attack livestock, which one is most reported?
1. Lion
 2. Jackals
 3. Leopards
 4. Hyenas
 5. Others, mention
6. Among wild animals that attack livestock, which one is most dangerous?
- 1 Lion
 - 2 Jackals
 - 3 Leopards
 - 4 Hyenas
 - 5 Others, mention
7. Among livestock that is being attacked by wild animals, which ones are most affected?
- 1 Cattle
 - 2 Sheep
 - 3 Goats

- 4 Donkeys
 - 5 Others, mention
8. At what time livestock are attacked mostly by wild animals?
- 1 During the day
 - 2 During the night
9. Among the wild animals, which one attacks livestock mostly during a day
1. Lion
 2. Jackals
 3. Leopards
 4. Hyenas
 5. Mention others
10. Among wild animals that attack livestock, which one attack mostly during the night?
1. Lion
 2. Jackal
 3. Leopard
 4. Hyenas
 5. Others, mention

Section B: Causes of human-wildlife conflicts in the NCA

1. What are the main causes of Human-Wildlife Conflict (HWC) in this area?

1. Competition over resources
2. Native traditions
3. Change of behaviour of wild animals
4. Change of behaviour of human
5. Others, mention

2. Among those HWC caused by native traditions which one is most reported?

1. Youth killing Lion
2. Youth killing birds
3. Others, mention

3. Among those HWC caused by the change of behaviour of wild animals, which one is most prevailing in this area?

1. Lactating wild animal
2. Older carnivores
3. Sick carnivores
4. Injured wild animals
5. Others, mention

4. Among those HWC caused by the change of behaviour by a human, which one is most prevailing in this area?

1. Persistence delay of consolation
2. Persistence of low amount of consolation
3. Low native benefits over conserving wildlife
4. Poor native treatments by NCAA Authority
5. Others, mention

Section C: The community perception on the trends of human-wildlife conflicts for the past 10 years in the NCA

1. Based on your knowledge and experiences on HWC in the NCAA for the past 10 years, what is your view with the following statements?

Statement	Respondent's opinion				
	Strongly disagree	Moderate disagree	Agree	Moderate agree	Strongly agree
i. The level of HWC has been increasing					
ii. Natives are becoming less tolerance to wild animals to HWC					
iii. The NCAA has been adequate addresses HWC					
iv. The level of HWC is becoming bigger than documented					
v. More means of reducing HWC are being discovered					
vi. Some type of birds are at risk of extinction due to killing by youth during the circumcision period.					

vii.	The level of native youth traditions killing lion has been increasing					
viii.	The community have been adequately involved in addressing HWC in the NCAA					
ix.	Reiterating killing of wild animals that have been practiced in the NCAA are increasing.					

Section E: Demography and Economic activities

1. What is your age? Tick one response below

A) Less than 20 years	B) 20 to 35 years
C) 36 to 50 years	D) More than 50 years

2. What is your education level?

A) No formal education	B) Primary education
C) Tertiary education	D) Others Specify

3. What are your main economic activities? Tick one response below

A) Government employee	B) Non-government employee
C) Self employee	D) Others; Mention

4. How long have you been living here? Tick one response below

A) Less than 12 months	B) 1 to 5 years
C) 6 to 10 years	D) More than 10 years

Appendix 2: Checklist

1. What are the current types of human-wildlife conflicts in the NCA?
2. What are the current causes of human-wildlife conflicts in the NCA?
3. What is the community perception of the trends of human-wildlife conflicts for the past 10 years in the NCA and compare among variables?
4. What are the community opinions on the best mitigation measure for combating human-wildlife conflicts in the NCA?

Appendix 3: Plagiarism Report

AN ASSESSMENT OF THE EFFECT OF HUMAN-WILDLIFE CONFLICTS ON SUSTAINABLE CONSERVATION IN NGORONGORO CONSERVATION AREA, TANZANIA

ORIGINALITY REPORT

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